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ENVIRONMENTAL IMPACT STATEMENT ON THE PROPOSED MONTANA POWER COMPANY AND PUGET SOUND POWER & LIGHT COMPANY ASSOCIATED FACILITIES (WATER SUPPLY SYSTEM) FOR COLSTRIP UNITS 1 & 2 ELECTRICAL GENERATING PLANTS AT COLSTRIP, MONTANA

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ENVIRONMENTAL IMPACT STATEMENT ON THE PROPOSED MONTANA POWER COMPANY AND PUGET SOUND POWER & LIGHT COMPANY ASSOCIATED FACILITIES (WATER SUPPLY SYSTEM) FOR COLSTRIP UNITS 1 & 2 ELECTRICAL GENERATING PLANTS AT COLSTRIP, MONTANA

January, 1974

Department of Natural Resources and Conservation
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1. Introduction

1.1 History

In August, 1972, Montana Power Company (MPC) made application to the Montana Department of Health and Environmental Sciences for a permit to construct a coal-fired electrical generating plant at Colstrip, Montana. Under the laws and regulations existing at that time, the Air Quality Bureau was to issue the permit if the applicant could meet all air quality standards and regulations. Under the Montana Environmental Act of 1971 (MEPA), an environmental impact statement (EIS) has to be written. Since the Air Quality Bureau was the lead agency, it took the responsibility for the EIS. In October, 1972 the Air Quality Bureau released the draft statement. A public hearing was held to obtain comments from interested parties in January, 1973 at Miles City, Montana. Written comments pertaining to the draft statement were received and the final EIS was released in late March, 1973.

Although the Board of Health and Environmental Sciences does not issue permits for construction, it must concur with the Department's decision. At its March meeting, the Board concurred with the issuance of the permit. The permit was granted on April 23, 1973. Construction of the facility, though, had begun in late 1972.

The Montana Utility Siting Act of 1973 became effective in March of that year. Section 11 (3) states that facilities or associated facilities under construction or in operation before January 1, 1973 are exempt from the Act. Units 1 & 2 of the generating complex were under construction before 1973, but the associated facilities (the water supply system and 230 KV line) for these units were not. Thus a certificate must be obtained for the associated facilities in accordance with the Utility Siting Act.

1.2 Present Application

Montana Power Company and Puget Sound Power and Light Company made application on June 29, 1973 to the Department of Natural Resources and Conservation (DNRC) for a certificate to build the associated facilities, consisting of a double circuit 230 KV transmission line from Colstrip to Broadview (north of Billings) and the water supply system, which is composed of the water intake and pumping station on the Yellowstone River, the 26-inch pipeline from the river to the power plant, the surge pond, and a 115 KV transmission line originating in Colstrip to supply the pumping station with power.

In October 1973 MPC applied for an amendment that would treat the original application as two applications. The water supply system was separated from the 230 KV transmission line. This study deals only with the water supply system and is primarily an investigation of the environmental impacts of the proposed activities. Montana Power Company has amended the water supply system application on several occasions. Listed below are the dates and content of these amendments.

On October 1, 1973, the company amended the size of the surge pond from an original capacity of 754 acre feet to approximately 1560 acre feet. This change resulted in the necessity of having to build a dike some 1500 feet south of the dam. The emergency spillway was moved from the south end of the dam to the north end.

In a letter dated November 2, 1973, the company changed the location of the 115 KV transmission line. The original application placed the transmission line along their preferred route for the proposed water pipeline. The map entitled, "Proposed Associated Facilities" shows the amended route.

On December 24, 1973, this agency received a letter which described minor changes in the location of the water pipeline.

The granting of permits for the generating plant itself is not an issue here. Likewise, the environmental impacts of the plant will not be discussed. Design features of the generating plant are not subject to change; thus, the alternatives of various types of cooling devices or changing requirements of the plant are not options. If the plant is to operate, as it is legally permitted to do, it must have approximately 20 cubic feet per second (cfs) of water (MPC, unpub.). The proposed water supply system, the environmental impacts likely to be created by the system, and the alternative methods of supplying the needed water are the topics of this report.

2. Methodolgy

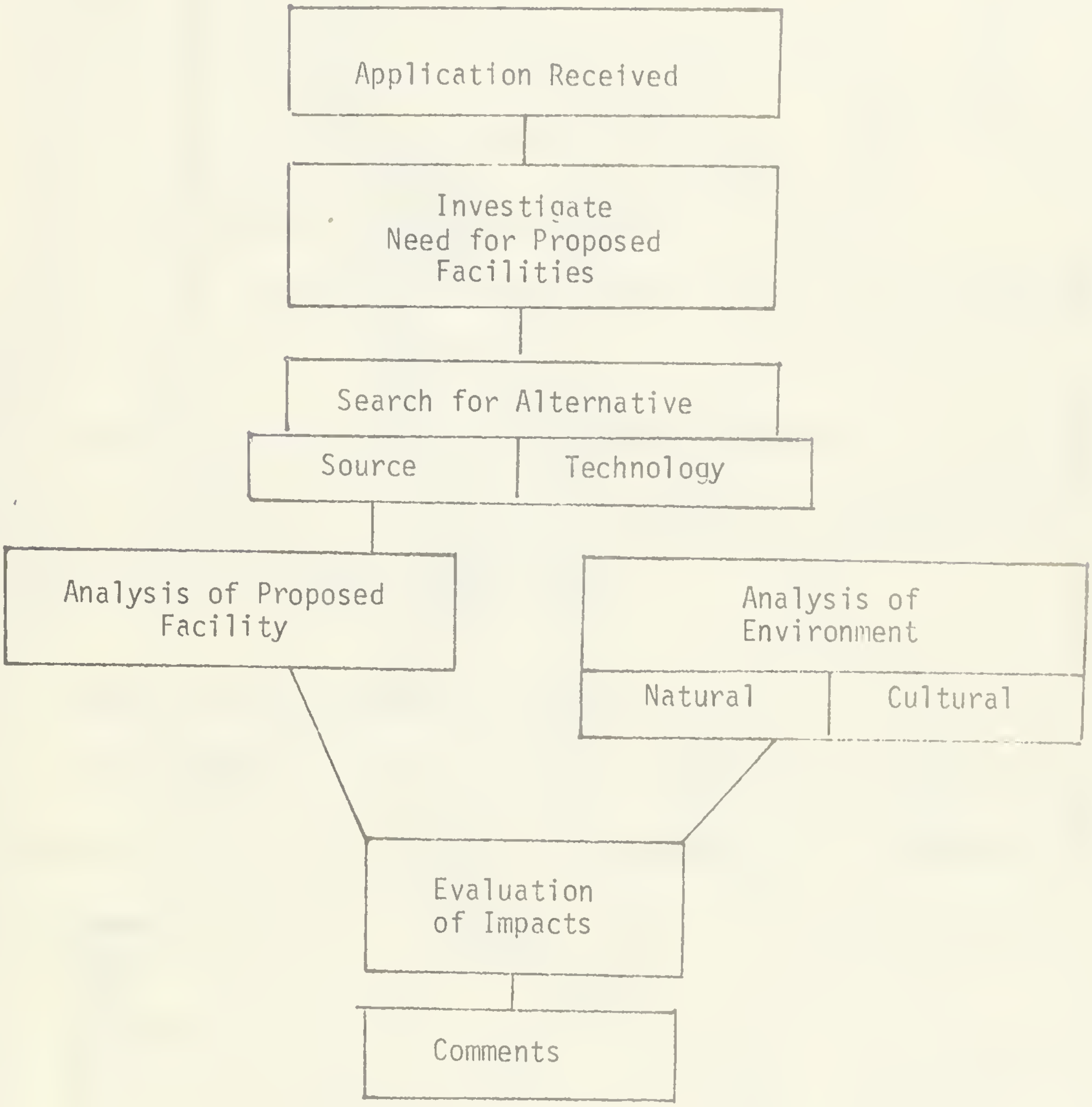
2.1 General Description

The evaluation of the application has followed a prescribed sequence. The first step is the determination of need for the utility facility proposed. If it is determined that a need exists, the next step is to examine various alternatives, sources and technologies. In this case the need was previously established by the granting of a permit to construct Colstrip 1 & 2. The alternative sources for the water and the power to operate the pumping station were investigated as were various technologies. The results of this study are reported in section 4.2.

Analysis of the facility as proposed by the applicant and of the area in which it is to be located follows. The analysis of the study area includes natural and cultural factors. Based on this investigation of the environment and the utility facility, an evaluation of the project can be made. Such an evaluation encompasses direct and indirect, long and short term impacts.

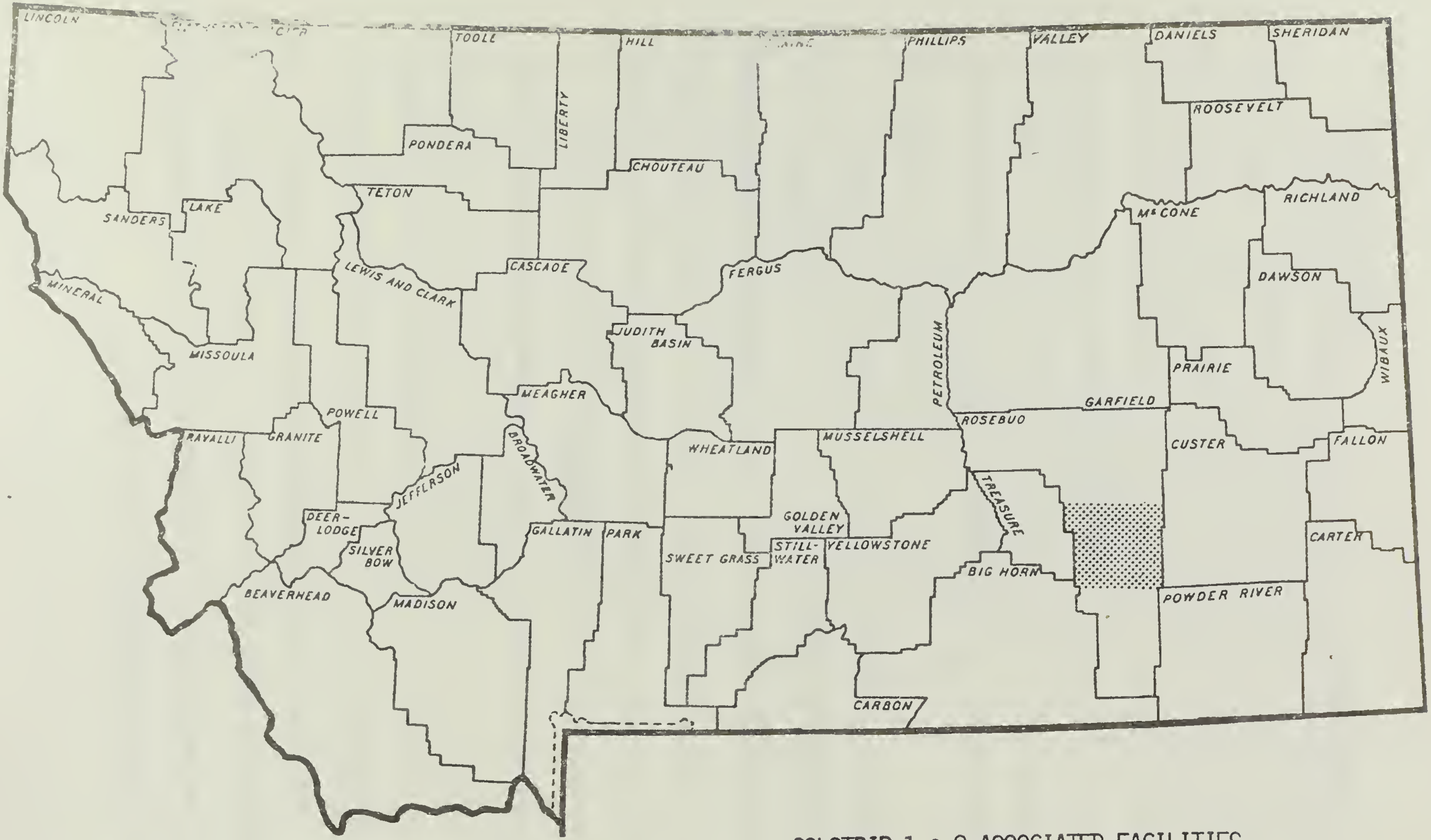
Chapter 5 is devoted to the environmental analysis, and Chapter 6 analyzes the environmental impacts expected. Chapter 7 provides comments on general considerations. In the final version of the environmental impact statement, specific recommendations will be made on the application so as to minimize adverse effects and maximize beneficial effects.

These steps are summarized in the following diagram:



2.2 Study Area

The study area was defined so as to include the geographic area in which there is the probability of impacts occurring from construction of the proposed utility facilities. The map "Colstrip 1 & 2 Associated Facilities Study Area" shows the boundaries of this study area.



COLSTRIP 1 & 2 ASSOCIATED FACILITIES
STUDY AREA

3. Proposed Action Description

3.1 Proposed Design Specifications

The proposed water supply system consists of the following:

1. Water Intake Structure and Pumping Station
2. Water Pipe Line From Pumping Station to Power Plant
3. 115 KV Transmission Line From Power Plant to Pumping Station
4. Surge Pond

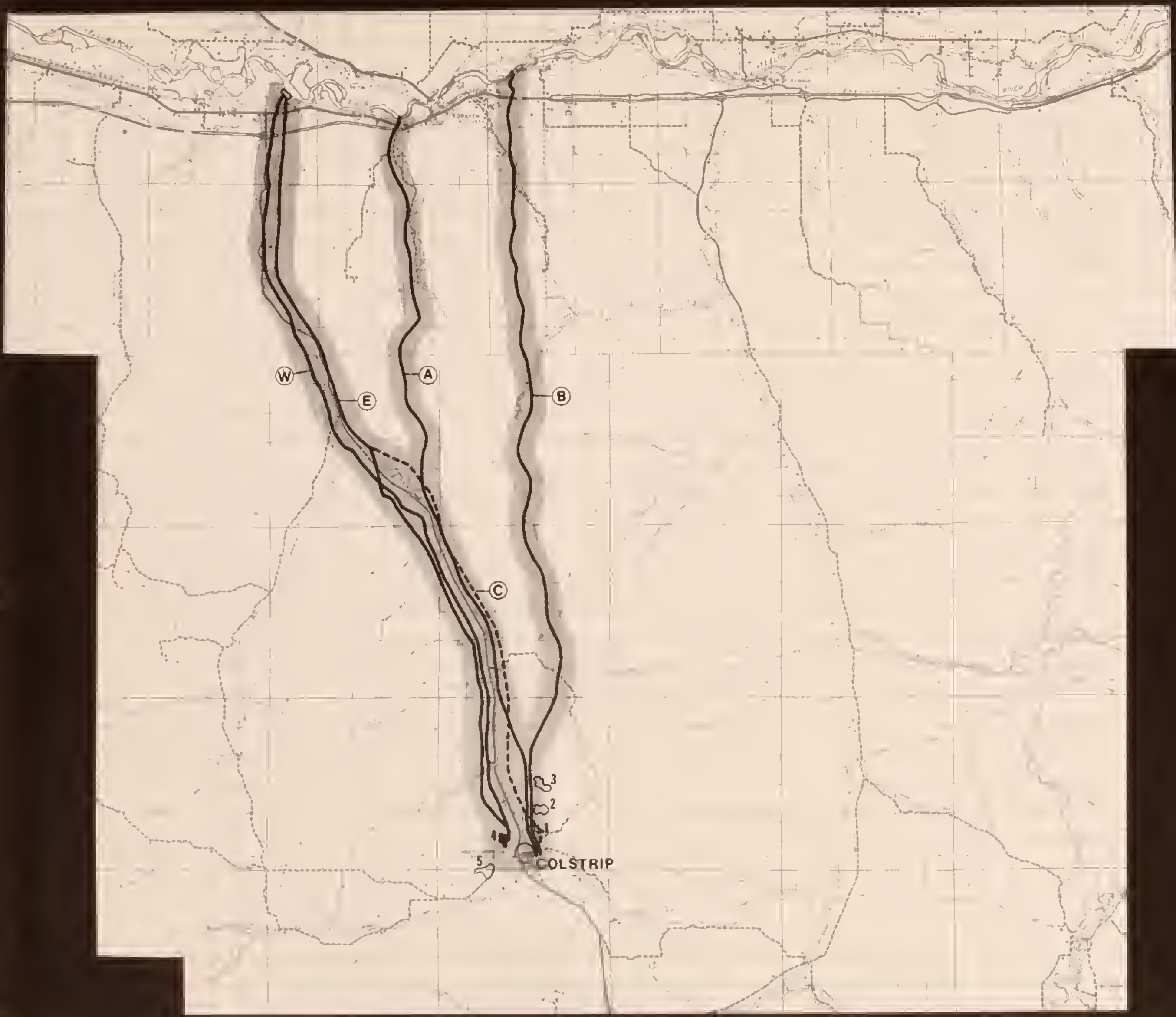
Specifications for these facilities are those provided by the applicants (Map: Proposed Associated Facilities). The applicant's proposed construction and reclamation will also be discussed.

3.1.1 Water Intake and Pumping Station

The proposed construction site for the water intake and pumping station is on the bank of the Yellowstone River on the Nichol's property, west of Forsyth (section 24, T6N R39E).

3.1.1.1 Water Intake

The water intake channel (Fig. 1) will be approximately 900 feet long. The main purpose of the intake structure is to minimize entry of ice, trash and sediments. Ice will be present in the Yellowstone River during winter months in the form of slush ice, drift ice, and solid surface ice. The trash to be expected consists of floating roots, tree branches, bushes, leaves, etc. The bulk of larger trash, present in the river during the spring, is expected to float past the intake channel with the strong main river current.



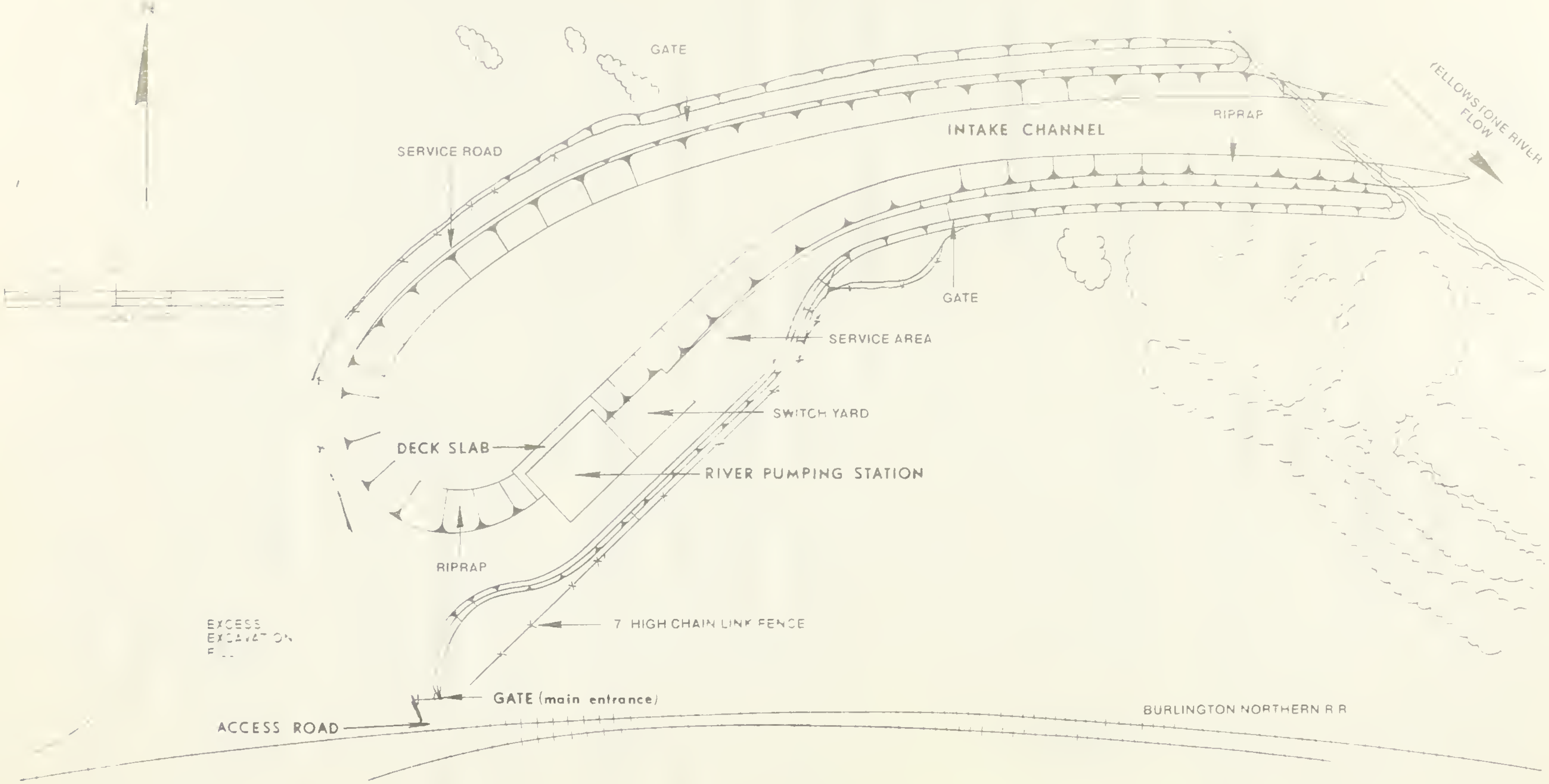
COLSTRIP UNITS 1 & 2 ASSOC. FACILITIES - WATER SUPPLY & 115 KV LINE

PROPOSED ASSOCIATED FACILITIES

LEGEND
- Ⓦ—PREFERRED PIPELINE ROUTE
- Ⓔ—PREFERRED POWER LINE ROUTE
- Ⓐ—ALTERNATE PIPE & POWER LINE RTE.
- Ⓑ—ALTERNATE PIPE & POWER LINE RTE.
- Ⓒ—ALTERNATE POWER LINE ROUTE
- ●—PROPOSED SURGE POND
- ○—ALTERNATIVE SURGE PONDS
- ▭—WATER PUMPING STATION

SOURCE. MPC 1972

ENERGY PLANNING DIV., DNR & C, HELENA, MT. • SCALE: 1/2" = 1 MI.



LOCATION AND LAYOUT OF THE YELLOWSTONE RIVER PUMPING STATION

Fig.

Sediment will be heaviest between May and October and consists of bed load and of suspended particles of fine sand, silt, and clay. The suspended sand will settle out in the intake channel where water velocity is greatly reduced. Approximately 2000 cubic yards of sediment are expected to be removed per year. The intake channel will have a total storage capacity for sediment of about 6000 cubic yards. Periodically the sediment will be dredged, stockpiled, and removed to a waste disposal site.

The intake structure will be constructed of reinforced concrete supported on spread foundations (Fig. 1). The concrete walls will be designed to withstand full hydrostatic pressure differences with the structure full of water. Earthquake and wind and snow loads, consistent with the location, are being considered in the design. The deck slab of the intake structure will form the floor of the pumping station.

3.1.1.2 Pumping Station

The pumping station will be required to supply 20 cfs of water. The capacity of the pumping station is dependent on the peak water requirement of the steam plant.

In a normal year the water requirements for the power plant are established to be as follows: (MPC, unpub.)

Units 1 and 2 (700 Megawatts total capacity)

Make-up Water	17.8 cfs (cubic feet per second)
Mist - Elimination Wash Water	0.4 cfs

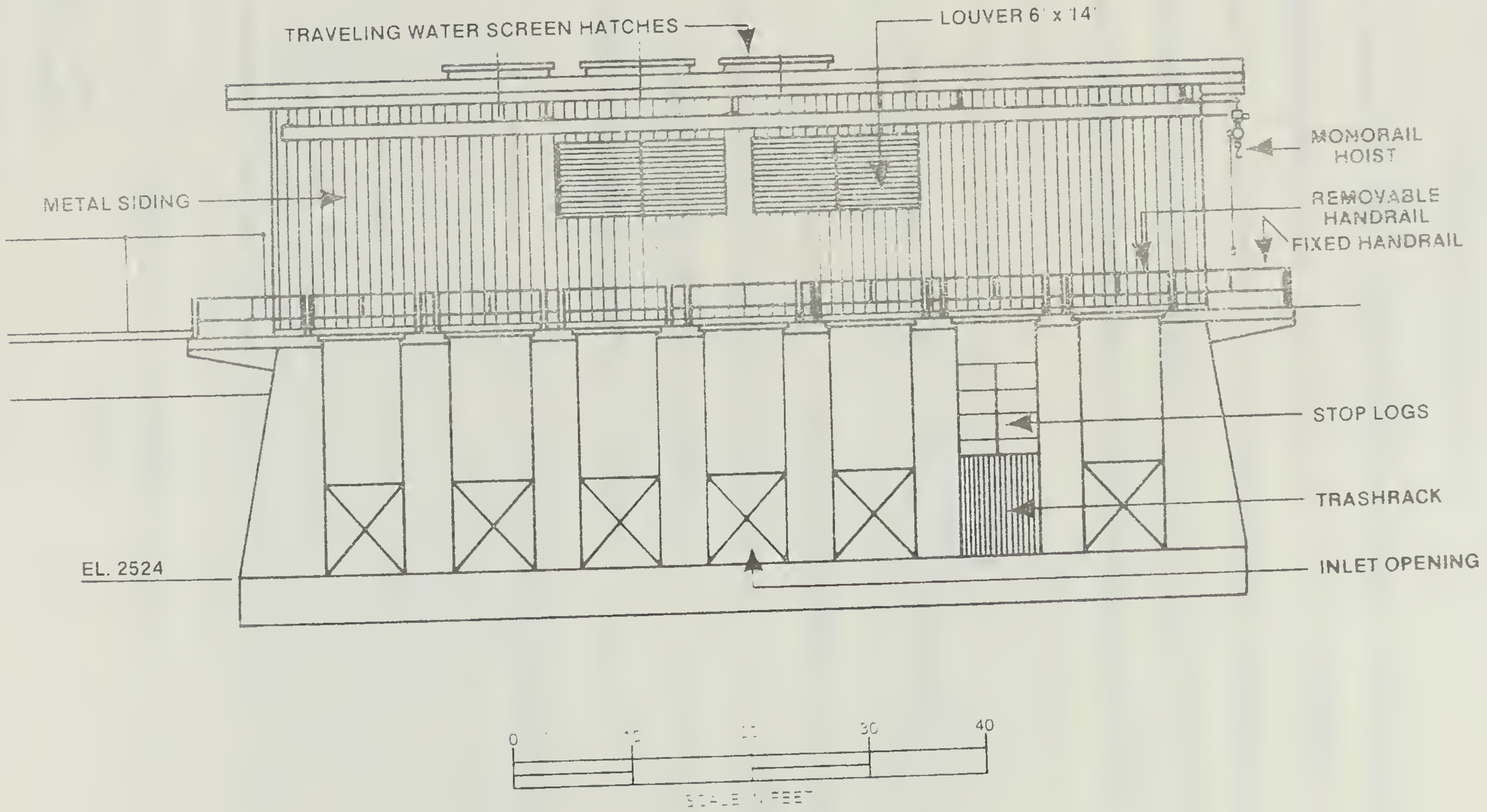
Surge Pond Evaporation	1.0 cfs
Surge Pond Seepage	0.6 cfs
Town of Colstrip Water Supply	1.8 cfs
TOTAL	21.6 cfs

Because of the uncertainty of the surge pond seepage rate and evaporation, the peak water requirement was rounded to 22 cfs (9873.6 gallons per minute) by the applicant. The volume of water and head requirement determine the pump size. The head requirement for water of 22 cfs (MPC, unpub.) in a 26-inch water pipeline is calculated in the following way:

Static lift (Difference between elevations of pumping station and surge pond)	751 feet
Friction Loss (in a 26-inch water pipe line)	554 feet
TOTAL Pumping Head	1305 feet

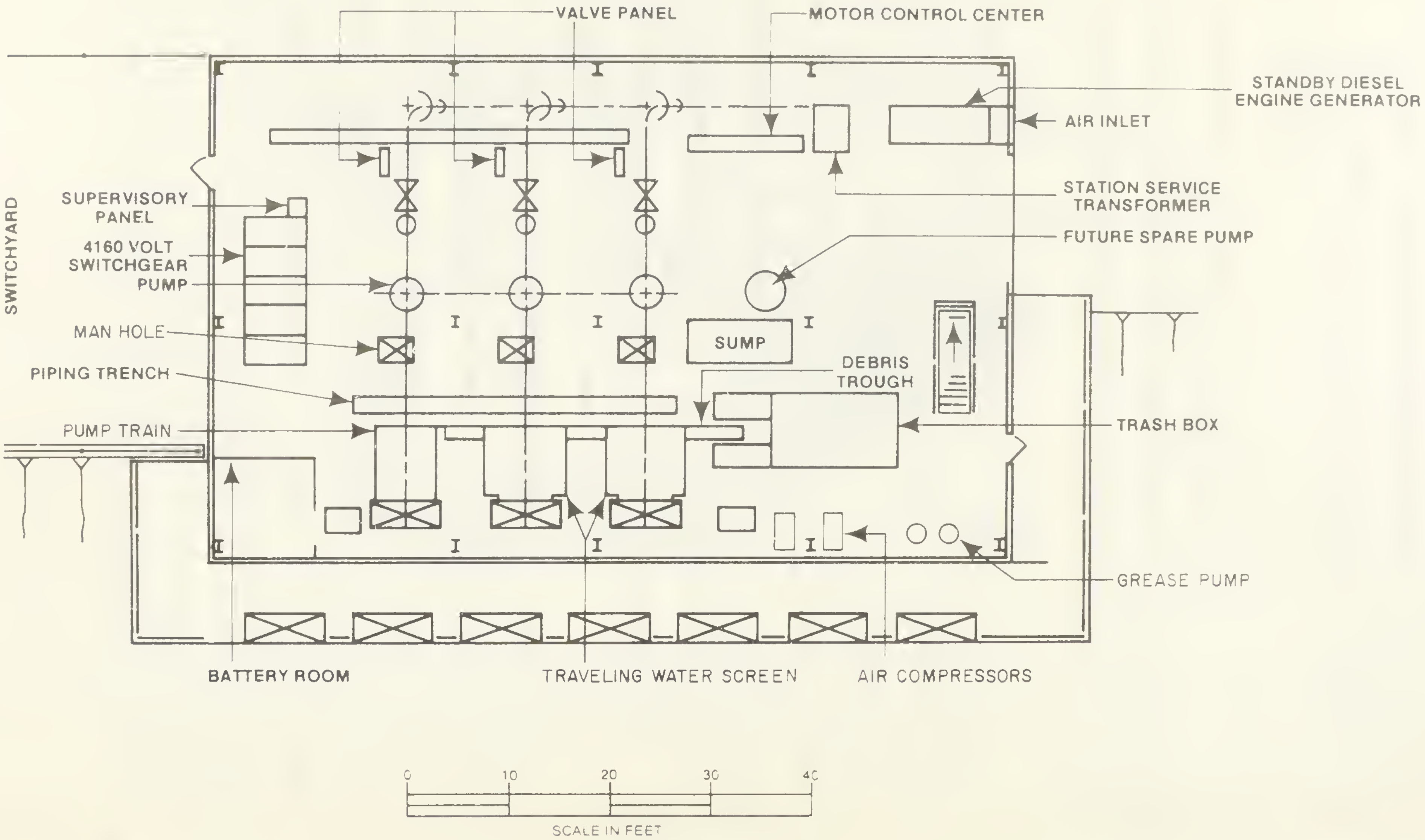
The pumping station would be a steel frame building with insulated metal siding and a corrugated metal roof with insulation and felt and gravel roofing material (Fig. 2).

The applicant intends to use a 4000 horse power (HP) capacity pump for Units 1 and 2 water supply system. There is space reserved for two more pumps of the same capacity for possible future expansion of the power generating plant and for one spare pump (Fig. 3). Each pumping unit consists of a trashrack, gate, stoplog, traveling screen, screen wash pump,



FRONT ELEVATION OF PUMP STATION

Figure 2



LAYOUT OF PUMP STATION

Figure 3

river water pump, outlet and other accessories. Each such series is termed a pump train (Fig. 4). Brief discussions of some of the main elements follow:

Each of the seven water intake openings (Figs. 2 & 3) will be provided with a trashrack to safeguard against entry of floating debris. The trashracks are designed to withstand a ten-foot difference in water level. The trashracks are removable for cleaning and one extra trashrack will be kept available.

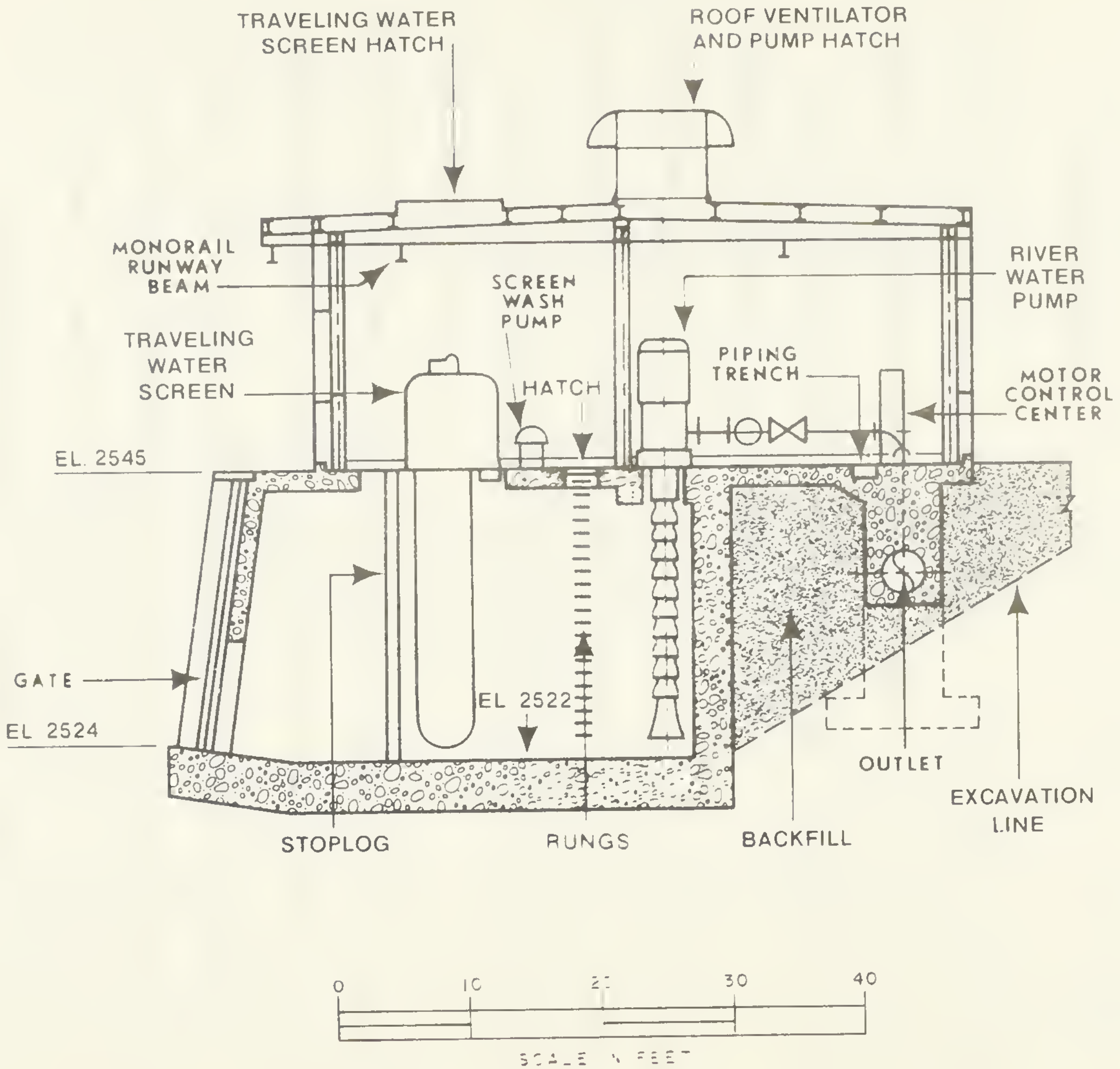
Stoplogs to regulate intake openings are designed for 20 feet of differential water head. Each inlet opening is provided with a stoplog, with (Figs. 2 & 4) additional stoplogs stored in the pump station.

A traveling water screen consists of a series of overlapping trays mounted on two strands of roller chain. These traveling water screens are designed to backwash automatically at regular time intervals by water sprays. The backwash water is to be collected in a trough and shunted to a trash box. Three water pumps are provided for this purpose. Other accessories (i.e., sump, debris trough, air compressor, grease pump, and piping trench, are shown in Fig. 3). All water intake and pumping station facilities would be fenced.

An access road to the water pumping station would be constructed from an existing grade crossing of the Burlington Northern Railroad, along the side of a hill, and around both sides of the intake service area.

3.1.2 Water Pipeline

The pipeline would extend from the Yellowstone River (section 26, T6N, R39E) along Armell's Creek to the surge pond located about 1 mile northwest of Col-



PUMP TRAIN

Figure 4

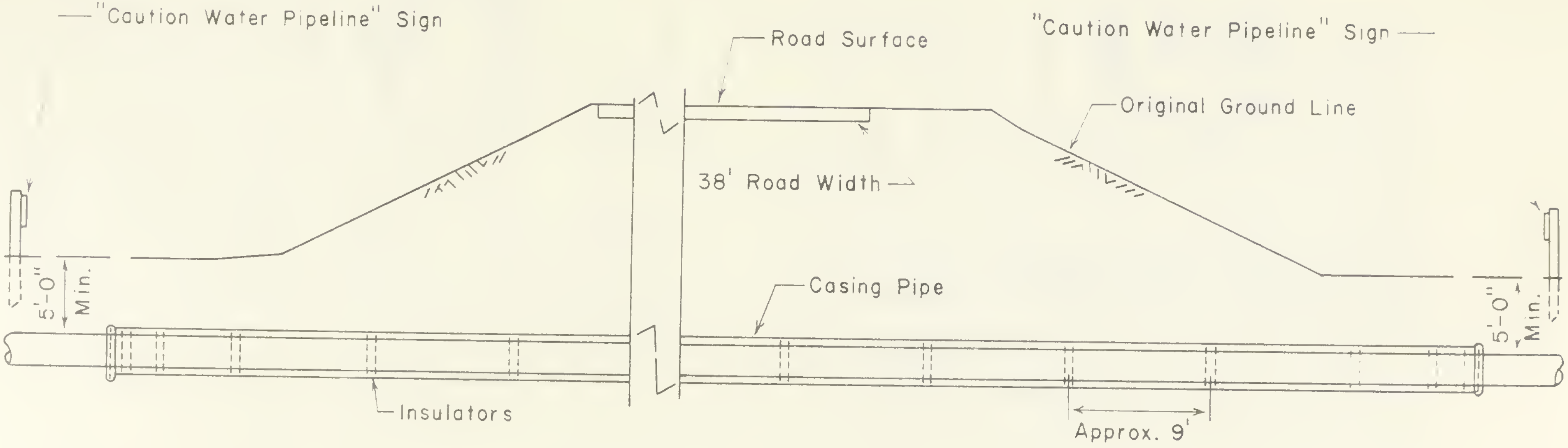
strip (section 28, T2N, R41E. Possible locations for the pipeline are given in section 4.3.2. The pipeline would be a continuously welded steel pipe of 26" diameter, coated with coal tar enamel, and provided with cathodic protection. The pipe would be in 80-foot lengths and installed by standard cross-country construction practices, including field bending. To avoid damage by frost heaving and settlement, the pipe is to be buried approximately 5 feet below the ground surface. Casing pipe would be used to protect railroads and highways (Figs. 5 & 6).

The applicant states that during construction a maximum of 65 feet of right-of-way will be needed, and all trees and brush inside the right-of-way boundary would be cut and removed. The detailed construction methods are discussed in section 3.2 of this report.

After completion of the pipeline installation, including all bedding and backfilling, hydrostatic testing is scheduled to check for leakage in the joints. The pipeline is to be tested at a pressure of 900 pounds per square inch.

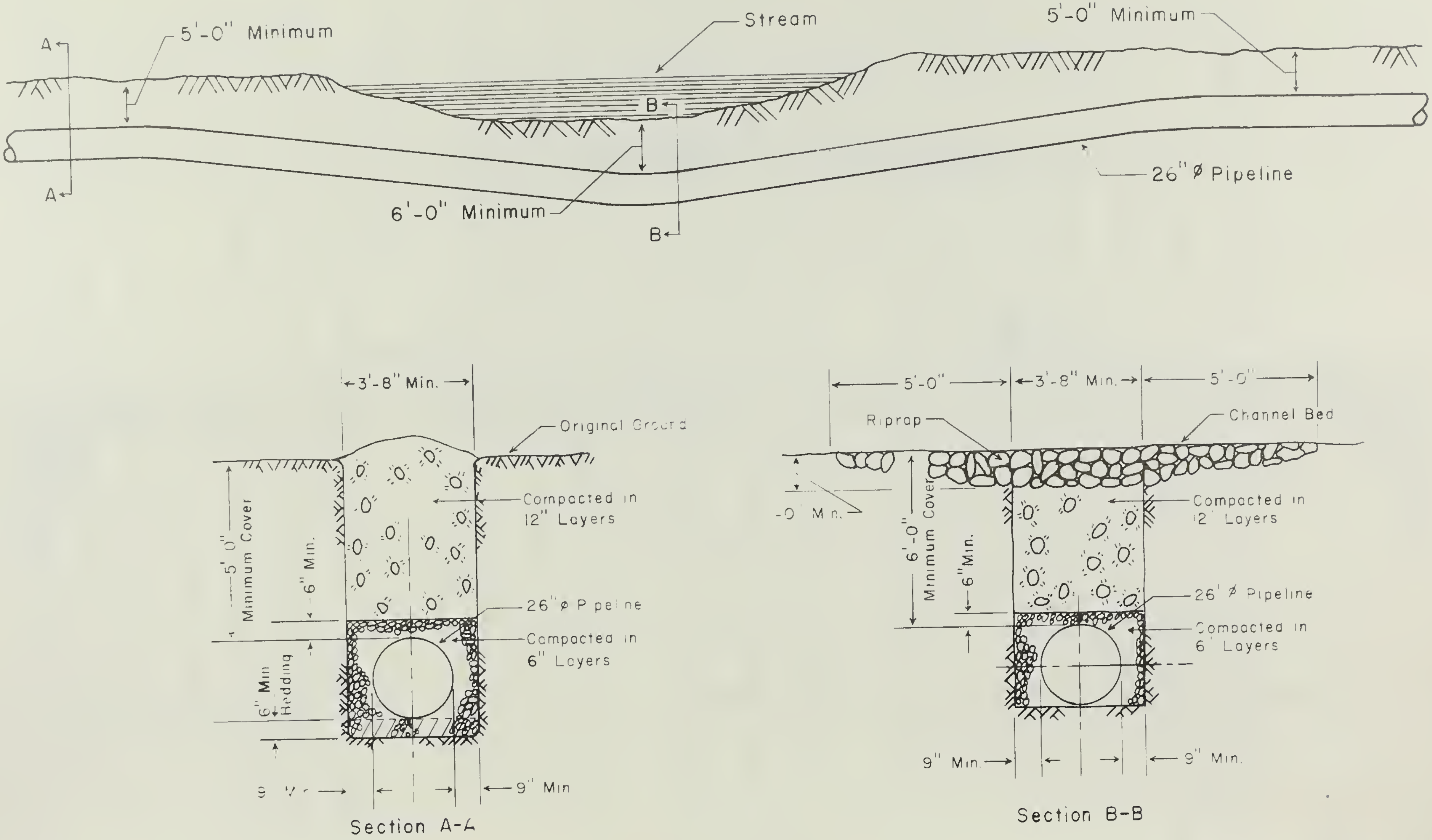
3.1.3 Transmission Line

Each pump requires 3 megawatts for operation. (MPC, unpub.) The proposed transmission line would be able to provide about 90 megawatts of power. The transmission line generally parallels the water pipeline (Map: Proposed Associated Facilities). The applicant intends to purchase easements only for the pole foundations, not for the entire 60-foot right-of-way. This line would have terminals in the Colstrip switchyard and the Nichols pumping plant substation. The applicants have indicated that the 115 KV line will



WATER PIPELINE UNDER U.S. 10 & OTHER ROADS

Figure 5



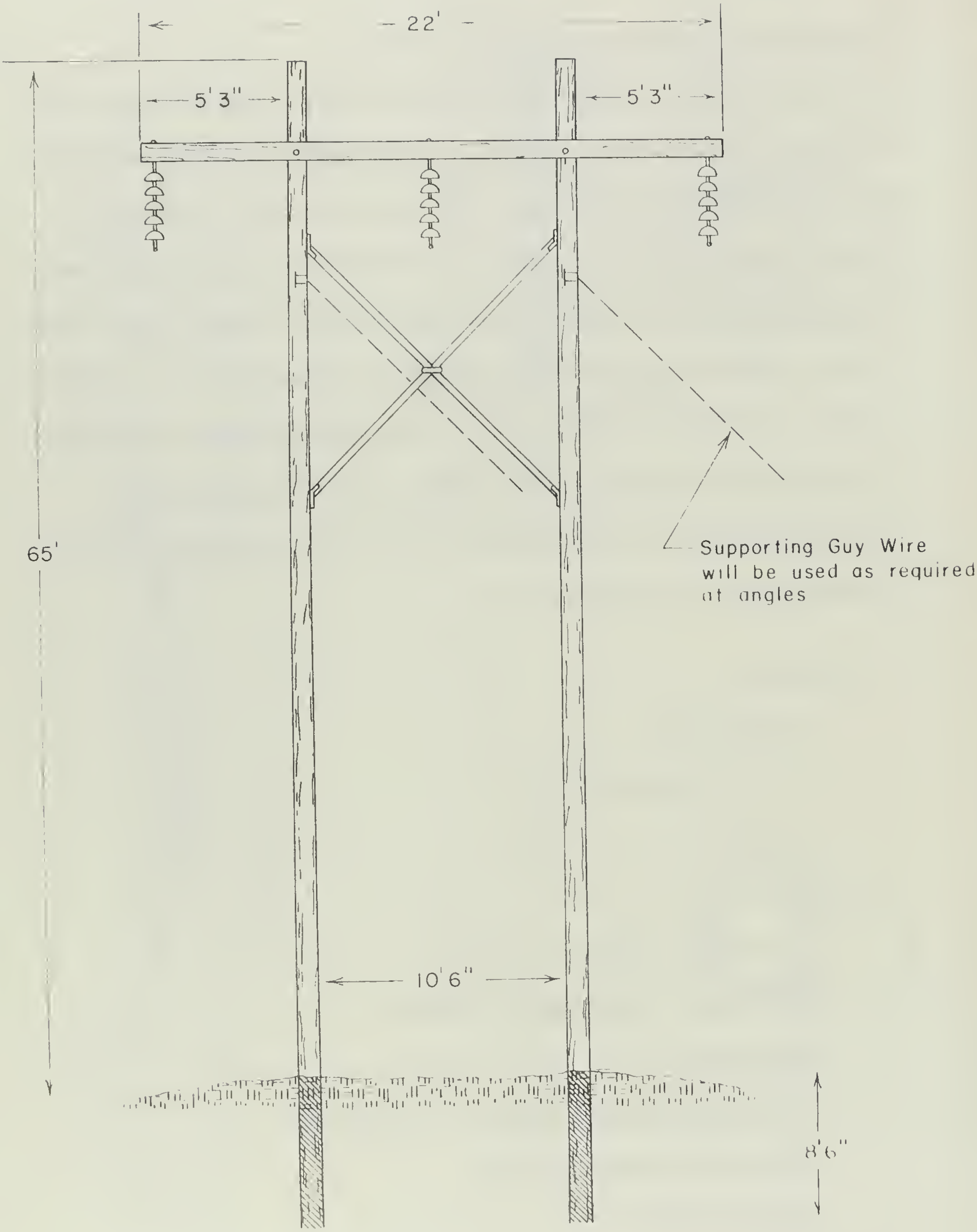
WATER PIPELINE WITH CROSS SECTIONS

Figure 6

not be interconnected with any other substations.

The applicants propose to use standard wooden "H Frame" pole structures and guys, as required (Fig. 7). Approximately 170 "H Frame" poles are to be used, with about 27 three-pole structures used at railroad and stream crossings. Also, all the poles are to have a grounding system and a static wire system. Construction of this 115 KV line should coincide with the U.S. Department of Commerce's Standards as described in the National Bureau of Standards Hand Book - 81, entitled *Safety Rules for the Installation and Maintenance of Electric Supply and Communication Lines*. Following are some of the specifications provided by the applicant for the proposed 115 KV transmission line:

1. Foundation
    - 8' deep in earth
    - 15" to 20" in diameter
    - dirt type
2. Tower
    - 65' height, 22' width (one arm)
    - natural color, wooden pole, "H Frame"
    - single circuit
    - self supported except at angle, crossing-guyed
    - string type insulator - 5 units
    - span 800' to 1300'
3. General



TRANSMISSION LINE SUPPORT STRUCTURE

Figure 7

336 mcm ACSR (Aluminum Conductor Steel Reinforced)

Conductor, diameter of .721 inch, non-reflective,

26 al strand, with center of 7 steel stands

(IR 11.5 mva IL - 58.7 mva)

Ground Clearance at middle, 28' minimum

10½' spacing wire

two static wires

115 KV operative voltage

105 mva maximum power (90 MW)

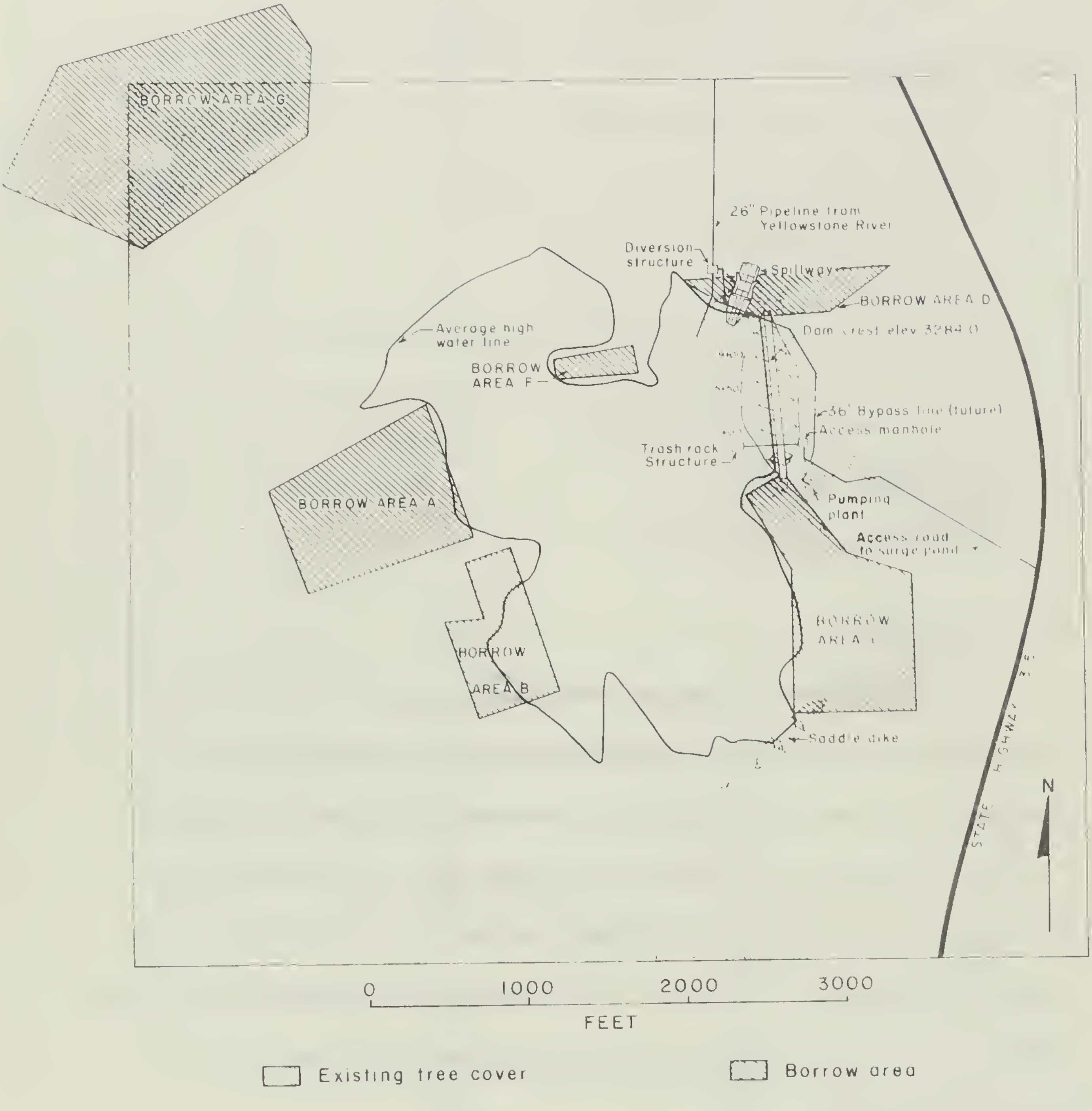
Cost, $468,000 total

Maintenance, $7,500 per year

3.1.4 Surge Pond

The function of the proposed surge pond is to provide water to the power plant in case of failure of the water pipeline, transmission line, or pumping station and to protect the Yellowstone River in times of low flow. The surge pond design includes a dam spillway and a saddle dike (Fig. 8). The location preferred by the applicant is one mile northwest of Colstrip in section 28, T2N, R41E. This site is in a partially cultivated east-west oriented valley, surrounded by low rolling hills with grassy slopes and scattered groves of pine trees.

A capacity of the surge pond is determined by water storage needs. Factors influencing the size of the surge pond are summarized below: (MPC, unpub.)



PROPOSED BORROW AREAS AND ASSOCIATED STRUCTURES OF SURGE POND

Figure 8

	Storage Volume (Acre-Ft.) (one acre ft.=325,900 gal.)	Water Surface Elevation (Ft.)
Dead Storage (35 years of accumulation of sediments)	350	3255
Live Storage (30 days of winter operations water for Units 1 & 2)	950	
Regulation Allowance	50	
TOTAL Winter Water Storage	1350	3272
Allowance for 3' of Ice	200	3
TOTAL Reservoir Capacity at Spillway Elevation	1500 1/	3275

Thus, the proposed surge pond will contain a normal maximum of 150 acre-feet of water and have a normal maximum surge pond elevation of 3275 feet. The 100 year flood level maximum is 3280 feet and is known as the maximum water level. An emergency spillway is to be constructed at this 3275 foot elevation which, in the event of an emergency, would allow overflow of water into a natural water course.

A zoned, rolled, earth-fill design is proposed for the dam. The different zones are to be compacted by rolling (using a sheepsfoot roller, a 50 ton rubber-tired roller, a trackroll, vibratory rollers, or an equivalent). Five different zones of material are to be used:

1/ This has been corrected by MPC to 1560.

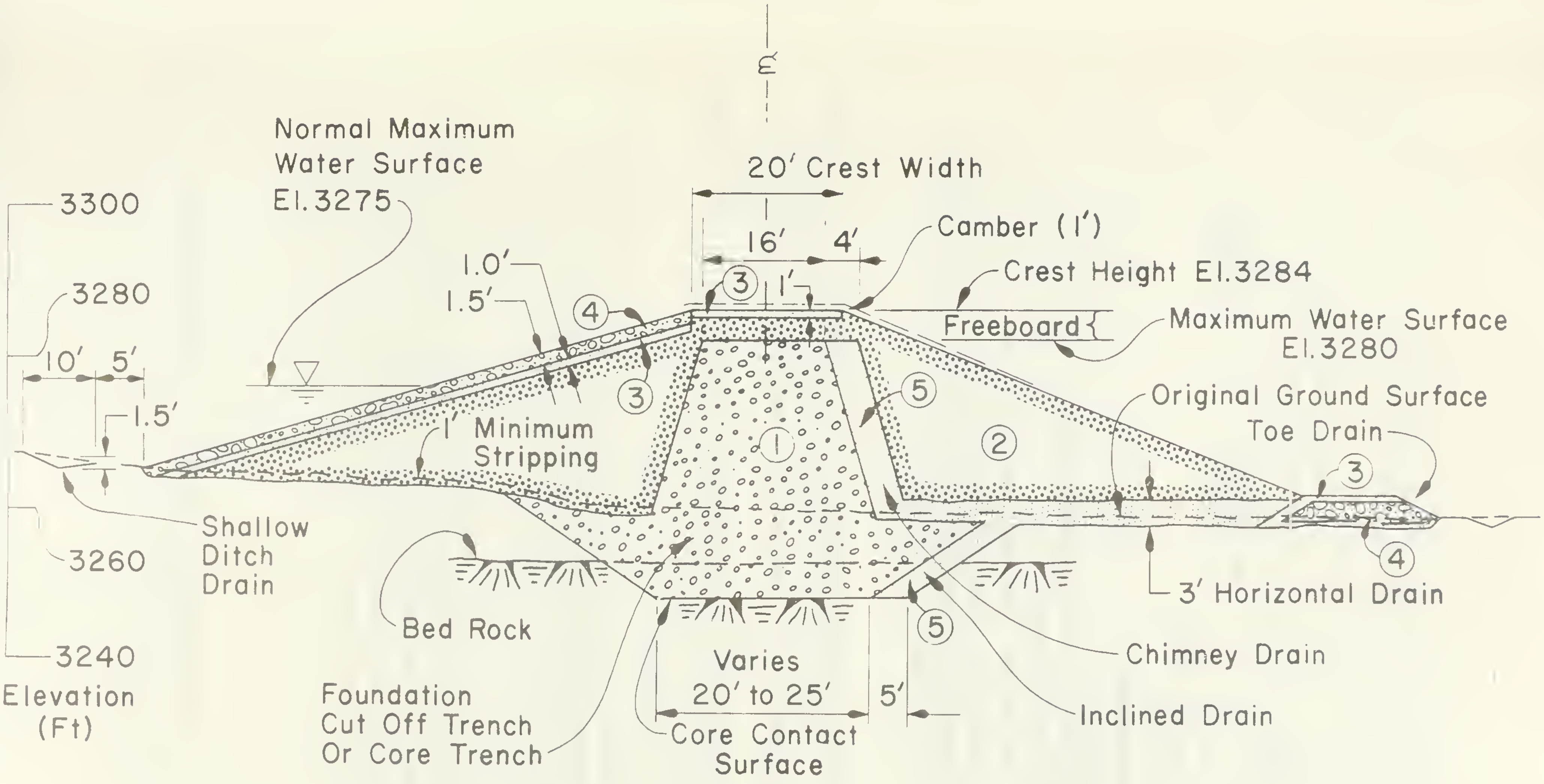
ZONES	MATERIAL
Zone - 1	core material (clay)
Zone - 2	shell material (sand & gravel mixtures)
Zone - 3	filter material (graded sand)
Zone - 4	riprap material (rocks)
Zone - 5	drainage material (gravels)

The applicant has selected seven different places, called borrow areas, to obtain the above material (Fig. 8). Borrow areas A and B would be sources of core material. Borrow areas C, D, E, F, & G would be sources of shell material. The filter material would be obtained from Forsyth Ready Mix Company. (MCP, unpub.)

In this type of dam the seepage rate through the dam and the stability of the slopes (downstream and upstream) must be considered. Protection of these slopes is important for dam safety. Dam safety and design is the responsibility of the applicant.

The Features of the dam (Fig. 9) are listed below: (MPC, unpub.)

Crest Elevation (ft.): 3284
Crest Width (ft.): 20
Crest Length: 1100 ft.
Maximum Camber at Crest of Dam: 1 ft.
Maximum Height
  Above Ground Surface: 56 ft.
  Above Deepest Foundation: 82 ft.
Cut off Trench
  Bottom Width (Total, Including Drains): 45 ft maximum
  25 ft. minimum
  (Core Contact): 40 ft maximum
  20 ft minimum



Zone No.	Material
①	Core
②	Shell
③	Filter
④	Riprap
⑤	Drainage

TYPICAL CROSS SECTION OF DAM

Figure 9

Maximum Depth from Ground Surface: 35 ft
Side Slopes: 1.5 Horizontal to 1 Vertical

Freeboard 1/ (Without Camber)
Normal - 10 ft 2/ (Above Normal Pool Level)
Minimum - 4 ft (Above Maximum Flood Level)

Slopes & Berms

	Horizontal	Vertical
Upstream: Berm 10' Wide at El. 3250)	3.5	1
Downstream:	2.5	1

Slope Protection
Upstream: 18 inch Maximum Riprap
Downstream: Grass

1. The normal freeboard should be based on wind velocity of 100 mph, at normal pool elevation.
2. Minimum freeboard should be based on wind velocity of 50 mph maximum pool elevation."

Since the normal maximum water surface level would be 3275 feet and one point on the perimeter of the surge pond site has an elevation of 3270 feet, a saddle dam (or dike) is to be constructed at that point. The following data is supplied by the applicant:

> The saddle dam (Fig.) in the southeast corner of the reservoir will be 600 feet long and a maximum of 14 feet high with a crest elevation of 3284 feet. The saddle dam will normally impound 5 feet of water.
>
> The design criteria applied to the main dam are also appropriate for the saddle dam. The saddle dam embankment is similar to that of the main dam with some simplification. The cut-off trench of the saddle dam will extend a minimum of 5 feet into rock which is expected to be encountered very near the existing ground surface. The bottom of the cut-off trench will have a constant width of 15 feet.

1/ The freeboard is the distance from the crest of the dam to the maximum water surface height in the dam.

2/ DNRC calculation is 9 ft.

A spillway has been designed to discharge water over the 3275 feet normal maximum level. The following quote is from the applicant's data:

> 12. SPILLWAY
>
> The spillway (Fig.8) is located on the left abutment approximately 150 ft. north of the north end of the dam. The spillway's ungated ogee crest is at the maximum normal pool elevation, 3275.0 ft.
>
> The crest width of 38 feet allows a probable maximum flood discharge of 1520 cfs with a pond surface elevation of 3279.9. A 100 year flood occurrence will discharge 121 cfs with 0.9 ft head over the crest. The approach channel inner elevation is 3267.9 ft.
>
> The 90 foot long concrete lined discharge channel terminates in the flip bucket. A 60 foot wide unlined stilling pool and an outlet channel is provided to convey flood flows to a natural drainage channel.

3.2 Proposed Construction and Reclamation Methods

3.2.1 General

The applicant has provided the following information on the proposed construction and reclamation methods for the facilities (MPC, unpub.).

> The construction phases will take place after negotiation of necessary easements or rights-of-entry with property owners. Construction activity along the right-of-way will be scheduled to avoid soil erosion at the time of peak seasonal run off. Any existing roads, culverts, bridges, public or private, used for right-of-way access will be restored to pre-use condition if damaged and maintained so as not to hinder or prevent use by the owner or tennant.

3.2.2 Transmission Line

3.2.2.1 Erection of Structures

The wood pole "H Frame" structures (including poles, cross-arms, and related braces) will be transported to each site unassembled. Excavation of the holes in which the poles will be placed will generally be accomplished with truck or tractor-mounted augers. However, in areas containing ledge or rock, blasting may be necessary. Complete assembly of the structures will be done on the site.

3.2.2.2 Stringing of Conductors

After each structure is assembled in the prescribed manner, insulator strings and conductors are to be installed. During the stringing operation guard structures will be placed along all highway and railroad crossings.

3.2.2.3 Right-of-Way Clean-up & Restoration

The clean-up is to be performed as a follow up to right-of-way preparation. Old fences would be repaired and new gates provided, as required, along the right-of-way. Where necessary, culverts and other drainage devices disturbed by this operation would be repaired or replaced to maintain existing drainage patterns, and to prevent erosion.

After construction has been substantially completed, so that there is no longer a need to move heavy equipment around structure sites and along the right-of-way, a second clean-up operation is to be performed in and around structure sites, along access roads, and in other areas where damage to the right-of-way might have occured. Excess materials would be picked up and removed from the general site, structure sites, and access roads, and other areas would be graded to prvent future erosion. Culverts and other drainage devices are to be repaired or replaced as required. Access roads and structure sites are scheduled to be reseeded with a cover grass indigenous to the area.

3.2.3 Water Supply Pipeline

3.2.3.1 Construction

The laying of the water pipe on the right-of-way is to be done in such a manner as to cause the least interference with the normal use of the land crossed, leaving gaps at intervals, to permit the use of the land and the passage of farm stock and farm equipment across the right-of-way or public roads or highways. Pipe laying is to be done in such a manner as to minimize hazards to traffic. Pipe is not to be strung on the construction right-of-way more than five miles in advance of line-up and welding.

The pipeline will be constructed by what is known as "Cross County" methods. The construction sequence is as follows (MPC, unpub.):

1. Clear and grub right-of-way: In general only that width of right-of-way actually required for the initial pipeline will be cleared and grubbed up to a maximum of 50 [1/] feet.

2. Grade of the right-of-way: It will be graded as required in order to perform the construction operations and provide access to the pipeline during construction.

3. Excavation of pipe trench: Following the grading operations the trench will be excavated to a minimum depth of 7 feet 8 inches and a minimum width of 3 feet 8 inches. Since construction operations will begin at the Yellowstone River, the spoil pile will be placed on the left or eastern side of the trench and construction operations will take place on the right or western side of the trench.

[1/] Subsequent data from MPC (Westinghouse Report, 1973) quotes 65 feet.

4. Stringing of the pipe: After the trench is excavated the pipe will be hauled to trenchside and strung alongside the trench. The stringing will be performed in a manner so as to cause the least interference with the normal use of land. Crossings and gaps will be left at intervals as required to permit the use of the land and passage of farm equipment across the right-of-way.

5. Welding into short sections: Following the stringing of the pipe the pipe will be aligned and welded together into a continuous pipeline. The bends will be made as cold field bends with a hydraulic bending machine. The bends will be laid out so that the pipe will conform to the bottom of the trench at substantially all points. After a joint is welded, it will be coated both inside and outside with coal tar or enamel.

6. Lowering in and backfill: After welding and coating of the joints, the pipe will be lowered into the trench and the trench backfilled. A sandy, gravelly type material will be placed around the pipe to a depth of six inches over the pipeline. Material from the trench excavation is then placed on the top of the trench.

7. Testing: Upon completion of the backfill operations the pipeline will be hydrostatically tested to insure that there are no leaks.

8. Clean-up: After completion of the backfill and the testing operations, the right-of-way will be cleaned and terrain on either side of the trench returned to its original contour and condition. All temporary gates will be removed and permanent repairs made to all fences.

3.2.3.2 Restoration

Upon completion of backfill and clean-up, the surrounding terrain is to be returned as much as possible to a similar condition as existed prior to construction. This will include smoothing of earth on both sides of the pipeline trench, hauling away all loose rock exposed by the construction operations, and, in cultivated farm land, thoroughly discing the soil as required by the land owner. The banks of all streams crossed will be returned to their original contour. The land would be contoured to its original appearance, soil replaced where it has been removed, and vegetation planted which would thrive and blend with existing plant communities.

3.2.4 Surge Pond

3.2.4.1 Dam Construction

The applicant stated that the dam will be constructed by conventional methods in a sequence similar to the following (MPC, unpub.):

1. Dewatering: A portion of the cutoff trench excavation will be performed below the water table. The water will be controlled by either pumping from sumps, a deep well system or a wellpoint system.

2. Cutoff trench: The cutoff trench will be excavated to depths of from 2 to 5 feet into competent bedrock. The excavated material will be stockpiled for future use in the embankment.

3. Fill placement: The material within the embankment will be obtained from previously determined borrow areas and will then be placed in the dam. The material will be moisture conditioned as necessary to assure that the desired compaction is obtained.

An approximation of the amount of borrow material available in four of the seven borrow areas is as follows (MPC, unpub.):

From	Borrow Area A	280,000 cubic yards of material	Zone 1
	Borrow Area D	22,000 cubic yards of material	Zone 2
	Borrow Area E	72,000 cubic yards of material	Zone 2
	Borrow Area F	200,000 cubic yards of material	Zone 2

3.2.4.2 Reclamation

Proposed reclamation methods for the borrow areas are to be as follows:

The topsoil will be stripped from the area to be excavated and stockpiled.

> After final grading of the subsoil during the construction work, all topsoil will be redistributed and graded. Reseeding, fertilization and irrigation will be done as necessary to re-establish vegetation. Temporary roadways will be filled, plowed and seeded as necessary to revegetation. (MPC, unpub.)

3.2.5 Water Intake and Pumping Station

3.2.5.1 Construction

The applicant has given the following proposed construction procedures for the water intake and pumping station:

1. Dewatering at the intake channel site and excavation for the channel structures, with stockpiling of earth removed.

2. Construction of concrete structures for the intake and pumping station, including reinforcement with steel, finishing of the concrete structure, backfilling, and forming contours to the intake channel banks.

3.2.5.2 Reclamation

The proposed reclamation methods for the water intake and pumping station are the same as those described above for the surge pond.

4. Need and Alternatives

4.1 Need for Proposed Facility

Since the need for the water has been previously established, it is only a question of where and how to obtain it. Existing facilities at Colstrip are not adequate to supply this need and cannot be expanded for this purpose.

4.2 Available Alternative Sources and Technology

4.2.1 Sources

4.2.1.1 Water

The alternatives for fulfilling the water needs are either ground water sources or a reliable surface source, such as the Yellowstone River. The use of ground water from deep aquifers does not appear to be a viable alternative for this project. Development of this resource would require a number of wells connected by an extensive network of pipelines. The total length of these pipelines would probably be far greater than the one proposed. By pumping the wells the number and spacing could be decreased, but much greater amounts of energy would then be required (Section 5.1.4.6). The advantage of using ground water is that the water would not be withdrawn from the Yellowstone River. There could be certain environmental hazards in the basin if large-scale pumping of the deep aquifers were conducted.

The surge pond is needed to store water so that a continuous flow will be guaranteed to the power plants. Greater storage capacity than proposed would lessen the potential for damage to aquatic life in the Yellowstone River during periods of extreme low flow by allowing shutdown of pumping. The alternative of having no surge pond would mean that the pumps at the intake would need to run continuously, regardless of river flow. Also, the power plant would not be supplied with water in the event the water pumps failed or were shut down for repair or the pipeline failed (blockage, rupture, etc.).

4.2.1.2 Power

The proposal is to construct a 28-mile 115 KV transmission line from the power plant at Colstrip to the intake on the Yellowstone. One possible alternative to this is to tap the Bureau of Reclamations's 230 KV line originating at Yellowtail dam and passing a few miles south of the water intake on the Yellowstone River (Map: Existing Land Use I). This alternative is being investigated further. The Bureau of Reclamation has stated that they are not sure at this time if they will have surplus power capacity after ten years to guarantee power to the pumping station. Other considerations mentioned by the Bureau of Reclamation in correspondence with this agency are as follows:

> Since all firm power resources of the Bureau of Reclamation are already committed to preference customers, such as REA Cooperatives, municipalities, and public power districts, we cannot contract for additional firm usage. It may, however, be possible for us to provide power transmission service (wheeling) on a surplus capacity basis with a delivery off the Yellowtail-Custer-Dawson line. When this surplus capacity may become available, the duration of the availability, and whether the delivery could be from the western or eastern system, depends to a large extent on the outcome of our present negotiations with power entities doing business in the vicinity of the East-West ties generally south of Yellowtail. To serve a new 50-mw wheeled load at 13.8 KV in Rosebud County off the Bureau line, a substation costing over $2.0 million could be required with the cost depending to some degree on the permanency and system configuration for the wheeling service period. (Oleson, Dec. 20, 1973).

4.2.2 Technology

4.2.2.1 Water

Intake Structure

The objective is to get the water from the Yellowstone River to Colstrip by the most technologically feasible method. The intake structure along the Yellowstone River will act as a sediment basin to reduce the high sediment loads in the river, reduce the possibility of ice jams and serve as a housing for the pumps that are needed to pump the water uphill to Colstrip. The alternative of having no intake structure would mean that the water pumps would be located at the river's edge and would have to be shut down frequently because of blockage caused by debris, sediment and ice jams.

Pipeline

The possibility of using an open ditch to transport the river water to Colstrip is not feasible for three reasons:

1. The difference in elevation from the Yellowstone River to Colstrip requires static and dynamic head pressure that cannot be provided by an open ditch.

2. Water in an open ditch, unless in a concrete shell, would be lost to seepage and evaporation.

3. Water in an open ditch would be subject to pollution that would have to be removed before using it in the power plants.

The use of a concrete pipe, above or below ground is not feasible because the static head pressure required would be too great to be sustained by the pipe joints and because the concrete pipe is not flexible enough to withstand the turns and dips of the 29 to 30 mile proposed route. Therefore, the best conveyance material is steel pipe which can withstand high pressures and is flexible. Steel pipe also lends itself to treatment with a protective outer coating of fiber glass and coal tar enamel.

4.2.2.2 Power

The possibility of placing the powerline below ground instead of above ground has been considered. For underground cables to be operated at various transmission voltages, (i.e., 69 KV, 115 KV, 138 KV, 230 KV or 365 KV) a very high quality voltage cable insulation is required. In the past few years high voltage cable insulation has been improved to the point that it is adequate up to 365 KV. However, the cable cost is very high, approximately 12:1 compared to an equivalent overhead transmission line. (This cost figure is for a line shorter than 25 miles for 115 KV and 138 KV.) Longer lines will have special problems (like charging currents) which increase costs. In addition, underground systems require costly trenching, cable terminals, and additional labor. The ultimate cost can go as high as 20 times more than for overhead transmission lines.

The use of DC transmission lines in place of AC lines is not economically feasible because of the short distance involved and the large acreage required for a substation to convert DC back to AC current. The use of DC transmission is considered as a practical alternative for lines greater than 400 miles.

4.3 Alternative Sites and Corridors

The map "Proposed Associated Facilities" shows the location of all alternative sites and corridors for the water system components and transmission line. Further descriptions follow.

4.3.1 Intake Structure

Alternative site A, which is the location preferred by the applicant, is in Section 24, T6N, R39E on the Nichols property. The river bed at site A is stable, and river characteristics would require less maintenance (silt removal) compared to a site where the river meanders away from the intake structure. The possibilities of ice jamming would also be less at this site.

Alternative site B is located about two miles west of Forsyth, on the section line bordering sections 21 and 22, T6N, R40E. The applicant states the following reasons that this site was rejected. The site is unacceptable because the river is subject to meander in a direction away from the intake structure which would result in heavy silting of the intake area. If site B were used, steps would have to be taken to prevent the natural meandering. Also, extensive maintenance of the intake would be required. There is an indication that large chunks of ice tend to collect in the area. The unstable river bed, the possibility of extensive maintenance, and the presence of ice jams at that location detract from the feasibility and desirability of this site.

Alternative site C in section 17, T6N, R41E is about two miles east of Forsyth. The applicant states that this site is subject to ice jams. Our investigation states that this site would entail a greater than 170-foot rise which is not feasible. Also, the railroad tracks would have to be relocated because the 20-30 foot distance from the river's edge to the nearest track is not enough room for an intake structure 900 feet in length, a fact of which the applicant is apparently unaware.

4.3.2 Pipeline

The pipeline route preferred by the applicant (Map: Proposed Associated Facilities) starts in section 24, T6N, R39E and runs south approximately 29 miles to surge pond site 4, section 28, T2N, R41E. A detailed description of this route is as follows (parentheses inserted):

> From the pump houses the line(s) will run southward approximately two miles, crossing the main line of the Burlington Northern Railroad, the spur line to Colstrip, old U.S. Route 312, and will cross beneath Interstate 94. From here, the pipeline(s) veer slightly westward through two miles of Armell's Creek floodplain to intersect Route 315 which follows the western edge of the floodplain. After crossing the road, the pipe line(s) leave the floodplain to follow 300 to 800 feet west of the road for about 5 miles through rangeland and some ponderosa pine savannah. The waterline(s) will again enter the floodplain where Route 315 crosses east of the Burlington Northern Railroad.
>
> The pipeline(s) will then parallel the railroad on its western edge through 5 miles of floodplain to where the road recrosses westward of the railroad into the East Fork Armell's Creek valley. From this point from 15 miles to the surge pond, the pipeline(s) will follow the western edge of the road through rangeland, ponderosa pine savannah and a half mile of irrigated land. With the frequent meandering of Armell's Creek within its floodplain there will be over 20 crossings of the creek bed. (MPC, unpub.).

This is the route preferred by the applicant because construction would be easier over most of the route, access is good, and revegetation would be relatively easy.

Route A (26 miles long) starts on the line between section 21 and 22, T6N, R40E, parallels Smith Creek for 14 miles then coincides with the preferred route for approximately 12 miles. This line goes through less cropland than the preferred route and crosses streams fewer times. The main disadvantage of the route is that access is poor in the northern part. This would mean that additional roads would have to be built which could increase the potential for erosion and disturbance of plant and animal communities. Cost of this line is much higher than for the applicant's preferred route. Erosion potential is increased on slopes which delays or prevents reclamation.

Alternate B (about 28 miles long) starts in section 17, T6N, R41E and runs southward for 28 miles, crossing Slaughter House Creek and West Rosebud Creek. The advantages of this route are that streams are crossed fewer times (only 3 to 4 times) than for the preferred route, and route B does not go through critical hay bottomland. The main disadvantages according to the applicant are: (1) it reaches the highest elevation; (2) it has the roughest terrain and would require the most side-hill land and rock excavation; (3) the access is poor over 50% of the route; and (4) erosion potential is moderate (Map: Erosion Runoff).

4.3.3 Transmission Line

The applicant's preferred route from Colstrip to the Nichols pumping station on the Yellowstone River is described in section 3.1.3 of this report. This route is preferred by the applicant but no explanation for this preference is given in the application.

4.3.4 Surge Pond

Surge pond site 1 is located in section 27, T2N, R41E. This site is not desired because it has potentially greater seepage losses and less recreation potential than site 4.

Site 2 is in section 22, T2N, R41E. This was rejected by the applicant because it has no advantage over the other alternatives and seepage loss of water would be greater than for site 4 because of the nature of the materials that outcrop at the pond site.

Site 3 is located mostly in section 15 with a portion in section 22, T2N, R41E. This was not feasible for the same reasons as site 2.

Site 4, located in section 28, T2N, R41E is the site preferred by the applicant because of potentially lower water seepage losses, greater recreation potential and easier access from the plant site.

Site 5 is located southwest of Colstrip in sections 32 and 33, T2N, R41E, and sections 4 and 5, T1N, R41E. This site is not desirable because a higher dam would have to be built and its cost was estimated to be approximately one million dollars more (MPC, unpub.).

5 Site Description

5.1 Natural Environment

5.1.1 Climate

The only weather stations within the study area are at Colstrip (elevation 3,221 feet) and at Forsyth (a cooperative agreement station at 2,537 feet). Weather data are shown in Table 5.1.1. The climate is continental in nature with warm days in the summer and cold days in the winter. The mean annual temperature at Colstrip is 45.9°F, and extremes of 111°F and -40°F have occurred. Mean annual precipitation at Colstrip is 15.79 inches, with most precipitation falling in the April-September growing season. Mean annual precipitation at Forsyth (approximately 28 miles north of Colstrip) is 12.17 inches. Heavy snowfalls (6-8 inches in less than 12 hours) are not common in that area. The greatest daily snowfall (24 hour period) is just under 10 inches, and, occasionally, snowfall accumulates to a depth of a foot and a half or more at Colstrip. The area does not have prolonged periods of high humidity; the high humidity periods are usually only of two to three days duration. Thunderstorms are fairly common in the summer and occur 20 to 30 days a year. Hail and strong winds occasionally occur, but incidence is small. No tornadoes have been recorded in Rosebud County, but adjacent counties have recorded a few.

5.1.2 Vegetation

The study area is predominantly ponderosa pine savannah (Inter-Agency Range comm., 1949). The grasslands are predominantly mixed prairie. The

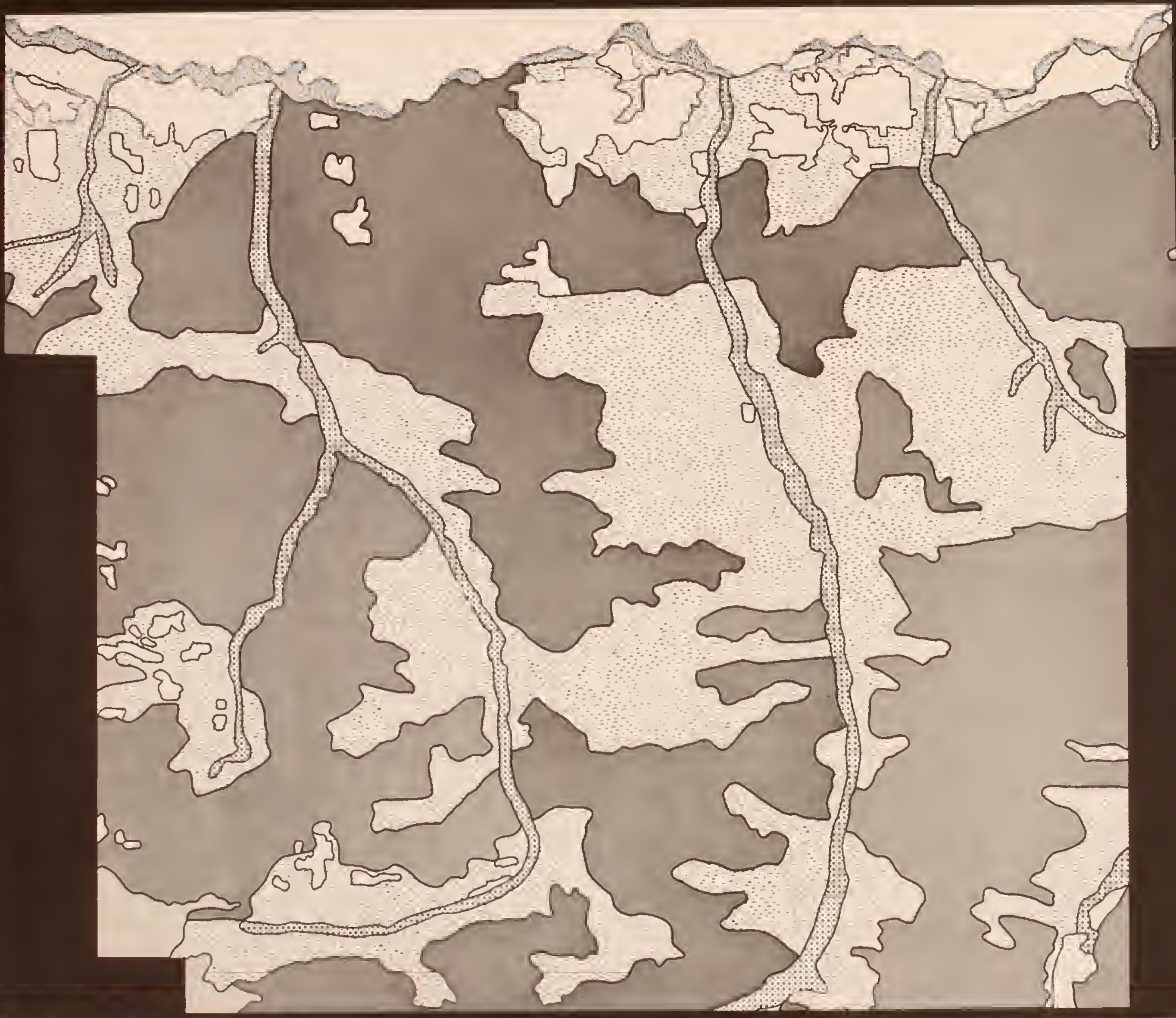
Table 5.1.1 Climatic Data

	Forsyth	Hardin	Hysham	Lame Deer
Mean Normal Temp. (°F)	46.0	45.9	46.0	45.4
Daily Maximum (°F)	59.9	61.3	61.4	61.5
Daily Minimum (°F)	32.0	30.6	30.6	29.3
Maximum Recorded Temp. (°F)	111	109	111	109
Minimum Recorded Temp. (°F)	-46	-42	-48	-40
Mean No. of Days Greater than 90°F	47	42	48	50
Mean No. of Days Less than 32°F	179	194	186	201
Annual ppt. (inches)	12.17	12.01	11.32	15.83
Yearly average snowfall (depth in inches, not moisture content)	31.1	33.3	--	--

Bureau of Land Management breaks the vegetation into six broad types: 1. pine-juniper, 2. grassland-sage, 3. cropland-hayland, 4. conifer, 5. brush-shrub and 6. broad-leaf trees (Map: Existing Vegetation). The first two are the most prevalent types.

The pine-juniper type occurs on the shallower soils on the slopes of the terrace breaks above the floodplain of the Yellowstone River and Armell's Creek. Dense, discontinuous ponderosa pine (*Pinus ponderosa*) stands are found on the north and east aspects of hills above the floodplain and in ravines and canyons east and west of the floodplain. Sparse scattered trees are found on the west and south slopes of the hills. In the study area the scattered pine stands are more numerous at the northern and southern ends of Armell's Creek. The pine stands play an effective role in preventing soil erosion and also serve as cover for wildlife, especially deer. In general, Rocky Mountain juniper (*Juniperus scopulorum*) is predominant on the poorer, droughty soils of the shaley breaks, and pine is predominant on sandy breaks. Associated with the pine-juniper type is an understory of blue-bunch wheatgrass (*Agropyron spicatum*). Winterfat (*Eurotia lanata*), which is very important for wildlife, is in greater abundance with pine on limey soils.

The grassland-sage occurs on the south and west slopes of the breaks in the study area and is predominant midway between Nichols and Colstrip (Map: Existing Vegetation). There are areas of pure grassland in this type. Grasslands are found on the nearly level tops of the hills on both sides of the creek. The occurrence of sagebrush versus grasslands is a reflection of land-use history and soil types. Generally, overgrazing has given sagebrush a com-



COLSTRIP UNITS 1 & 2 ASSOC. FACILITIES - WATER SUPPLY & 115 KV LINE

EXISTING VEGETATION

LEGEND

☐ GRASS - SAGEBRUSH
☐ BROADLEAF TREES
☐ CONIFER
▨ PINE - JUNIPER
☐ CROPLAND - HAYLAND
░ BRUSH - SHRUB
(INTERMINGLED CROPLAND - HAYLAND)

SOURCE
BLM 1972

ENERGY PLANNING DIV., DNR & C, HELENA, MT. · SCALE: 1/2" = 1 MI.

petitive advantage over grasses, and sagebrush has subsequently increased its range. Big sagebrush *(Artemisa tridentata)* prevails on shaley soils, and silver sage *(Artemisa cana)* is more abundant on well-drained, moist soils with low clay content. The mixed prairie grasses, as expected, also vary with the various soils. The two main phases are: 1. western wheatgrass *(Agropyron smithii)*, green needle *(Stipa viridula)*, and blue grama *(Bouteloua gracilis)* on silty, clay loam to clay loam soils, and 2. needle and thread *(Stipa comata)*, bluebunch wheatgrass, blue grama and threadleaf sedge *(Carex filafolia)* on silty loam to fine, sandy loam soils (Morris, 1973). More specifically, needle and thread predominates if the "A" and "B" horizons are silty loam. When there is clay or clay loam in the "B" horizon, then western wheatgrass will be found. A soil with sandy loam in the "A" horizon is characterized by the occurence of needle and thread, silver sagebrush, and bluebunch wheatgrass. Blue grama grass is not a good soil indicator because it grows on a variety of soils. Green needle grass is abundant on clay, vertisol soils, especially silty clay loam. Thread-leaf sedge is associated with needle and thread but is more abundant on very shallow, silty soils. Bluebunch wheatgrass grows on gravelly soils and appears also on soils that have cracks at the surface extending down into the "C" horizon where moisture can accumulate. The plant association of needle and thread, bluebunch wheatgrass, plains muhly *(Muhlenbergia cuspidata)*, phlox *(Phlox spp.)*, and legumes *(Leguminosae spp.)* occurs on terrace gravels.

The cropland-hayland type is found mainly in the floodplains of the

Yellowstone River and Armell's Creek. Some cultivated land is above the floodplain on nearly level terraces to the west of Armell's Creek about 1/2 to 3/4 of the way down the valley. Crops along the Yellowstone River include about one third each of alfalfa, sugar beets, corn silage and a small amount of beans. Essentially, all the fields in the Yellowstone Valley are irrigated. Hay is the primary crop in the Armell's Creek drainage, but some small grains are also grown. Irrigation is in the form of water-spreading during spring flooding.

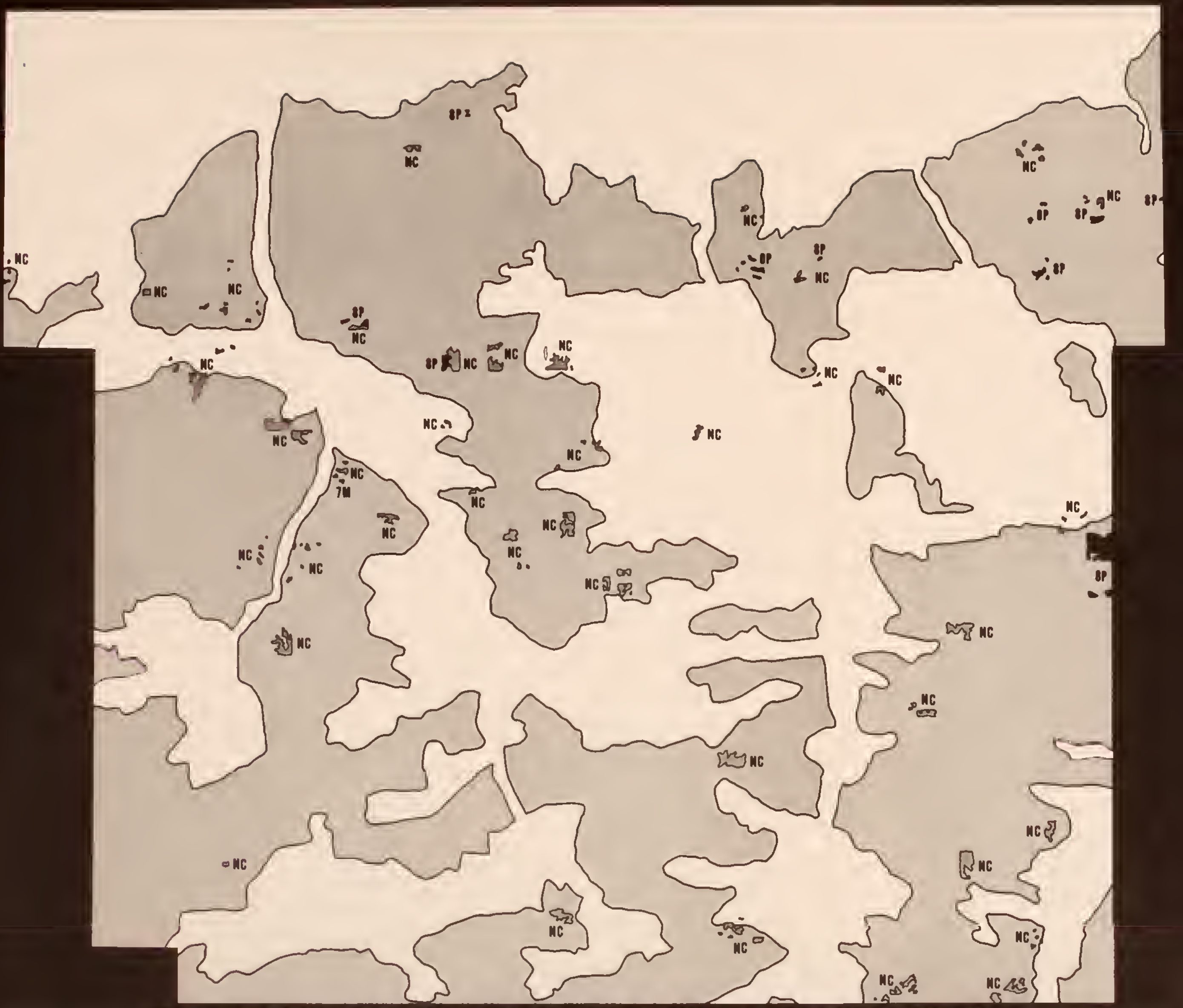
The conifer type is confined to the south sandstone outcrops in the western part of the study area. Ponderosa pine makes up the tree cover and bluebunch wheatgrass, idaho fescue *(Festuca idahoensis)*, sideoats grama *(Bouteloua antipendula)*, little bluestem *(Andropogaon scoparius)*, and skunkbush sumac *(Rhus trilobata)* comprise the lower or understory vegetation.

The brush-shrub type occurs in many ravines and coulees of the study area. Major species of this type are western snowberry *(Symphoricarpos albus)*, woods rose *(Rosa woodsii)*, willow *(Salix spp.)*, buffaloberry *(Shepherdia argentea)*, chokecherry *(Prunus virginiana)* and silver sagebrush.

The broadleaf type occupies the alluvial floodplains of the Yellowstone River and Armell's Creek. The greatest density is along the Yellowtone River and the northern and southern portions of Armell's Creek. At some points along Armell's Creek there are only a few isolated trees. The major species are cottonwood *(Populus spp.)*, willow, green ash *(Fraxinus pennsylvanica)*, and box elder *(Acer negundo)*.

The discontinuous stands of small diameter ponderosa pine are not able to support a lumber mill or even to contribute significantly to existing mills at Lame Deer and Ashland because of economics and road systems (Map: Timber Resouces). Some of the trees could be used locally for posts or poles.

By far, the predominant land-use is agriculture, and in particular, ranching. Livestock grazing (cattle, sheep, and horses) accounts for 88% of land-use in the study area. An indicator of range quality is the animal unit month (A.U. M.) per acre, in other words, the number of animals that can be supported by an acre for one month. The A.U.M. in the study area ranges from .2 to .25 (Warner, Pers. Comm.). This classified the study area as a fair to good range. The range is excellent from south of Colstrip to the southern boundary of the study area. Early historical records stated that suitable forage was sparse except in a few isolated areas near springs. Range condition is a reflection of how much of the original (or climax) native vegetation is still present. Overgrazing could change the present range condition from good to fair or poor. The records for the past five years indicate that, due to beef demand, the number of cattle is increasing. However, with good range management practices, which include deferred-rotation grazing, present range conditions could be maintained and even improved. Cheatgrass (Bromus tectorum), which is an invader, is increasing on some sites, but the cause may not be entirely a result of grazing animals. Poisonous plants are generally not much of a problem in the study area though death camas (Zigadenus spp.) could be a potential problem if overgrazing occurs. Cocklebur (Xanthium spp.) causes few problems but has been responsible for some



COLSTRIP UNITS 1&2 ASSOC. FACILITIES - WATER SUPPLY & 115 KV LINE

TIMBER RESOURCES

LEGEND

▢	TIMBER LANDS (ALL TIMBER IS PONDEROSA PINE)
▨	PROTECTION AREAS
■	PROTECTION AREAS TYPED AS COMMERCIAL
NC	NON-COMMERCIAL TIMBER
7	SAPLING SIZE
8	POLE SIZE
M	MEDIUM STOCKED ALL CROWNS
P	POORLY STOCKED ALL CROWNS

SOURCE:
BLM 1972

ENERGY PLANNING DIV., DNR&C, HELENA, MT. • SCALE: 1/2"=1 MI.

cattle losses due to poisoning. Noxious (undesirable) plants found in the area include Canadian thistle (Cirsium arvense), field bindweed, and leafy spurge (Euphorbia esula). Canadian thistle is on the increase throughout the study area and leafy spurge is migrating down the Yellowstone valley.

The irrigated floodplain of the Yellowstone River is used for growing sugar beets, corn and hay, about 1/3 each. Yields are about 20 to 25 tons/acre for beets and corn and 4-5 tons/acre for hay. Armell's Creek bottom land is used primarily for hay production, but some small grains are also raised. Native haylands yield about 1½ tons/acre, and introduced grasses and alfalfa yield 2½ to 3 tons/acre. Along the East Fork of Armell's Creek near Colstrip yields are from 4 to 5 tons/acre on small (40 to 50 acres) managed tracts (Warner, Personal Comm.).

5.1.3 Wildlife and Fisheries

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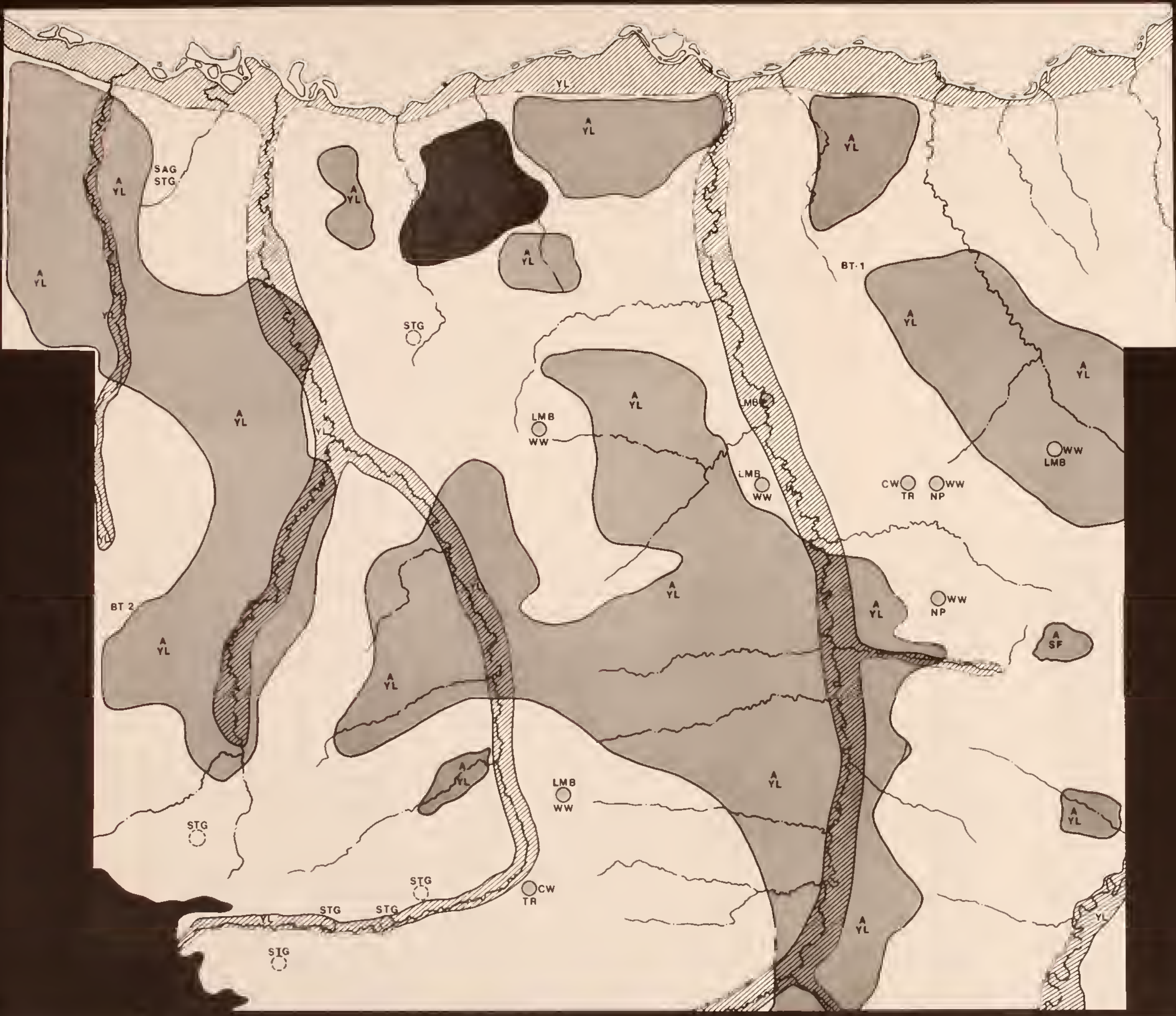
5.1.3.1 Wildlife

This report classifies wildlife according to their economic importance to man, i.e., big game, upland game birds, waterfowl, etc. The following wildlife information comes from the U.S. Bureau of Land Management inventories in cooperation with the Montana Department of Fish and Game (BLM, 1973).

Big Game

Mule deer (Odocoileus hemionus) and white-tailed deer (Odocoileus virginianus) both occur in the area, but the mule deer is of greatest importance in terms of number and habitat. As shown by the Wildlife-Fish (Existing) Map, mule deer range throughout the study area although they are found primarily



COLSTRIP UNITS 3&4 ASSOC. FACILITIES - WATER SUPPLY & 500KV LINE

WILDLIFE-FISH HABITAT (EXISTING)

A ANTELOPE	STG · SHARPTAIL GROUSE	BG · BLUE GILL	CW · COLD WATER HABITAT
■ TURKEY	○ · DANCING/STRUTTING GROUND	NP · NORTHERN PIKE	WW · WARM WATER HABITAT
▨ PHEASANT	YL · YEAR LONG APPEARANCE	LMB · LARGE MOUTH BASS	BT - BROWSE TRANSECT
SAG · SAGE GROUSE	SF · SUMMER/FALL APPEARANCE	TR · TROUT	

NOTE: DEER (MULE, WHITE TAIL), HUNGARIAN PARTRIDGE & SAGE GROUSE INHABIT ENTIRE STUDY AREA

SOURCE BLM 1972

ENERGY PLANNING DIV., DNR&C, HELENA, MT. SCALE 1/2"=1 MI.

in the uplands above the floodplains of the Yellowstone River, Armell's Creek and Rosebud Creek. The mule deer's winter range is near their summer range and is generally on south and east aspects (Burt and Grossheider, 1964). They utilize the cover of the pine-juniper vegetation type and in some places the rough "breaks" of the badlands. The mule deer's diet varies with the season. Knapp's study (1972) in Custer National Forest, Montana, found that in the summer the diet was forbs (47%) and browse (51%); in the fall, forbs (39%), grass (2%), and browse (59%); and in the winter, browse (96%). He found that the important browse species were skunkbush, rose, snowberry, big sagebrush, rubber rabbit bush (Chrysothamnus nauseosus), and silver sage. Studies made by the Montana Department of Fish and Game indicate that the browse is in good condition. Since the critical limiting factor to deer population is winter forage, it appears that the population is either stable or on an upward trend.

The habitat of white-tailed deer, although not shown on the map Wildlife-Fish Habitat (Existing), is limited primarily to the brushy, heavily wooded areas along Armell's Creek, Rosebud Creek, and the Yellowstone River. Although most of the bottomland is used for small grains and alfalfa, this type of land-use does not displace white-tail very much because these crops supplement the white-tail diet during the fall and spring. White-tail habitat is in good condition, and the population seems to be increasing.

Compared to other locations in eastern Montana, the study area is not a good antelope (Antilocapra americana) area. Some of the reasons are the discontinuity of grassland-sagebrush (which is their main vegetation habitat), rough, broken-up terrain, and severe winters that greatly reduce their numbers. Antelope use the cropland-hayland in the spring, summer, and fall. Various researchers have found that antelope populations are directly linked to the quantity and quality of sagebrush. In one study by Wentland (1971), silver sagebrush in the bottoms was found to be the key to winter survival. Cattle, grazing in the bottoms, compete with the antelope for shrubbery. Freeman (1971) found that the big sagebrush was most important for survival, followed by silver sage. Next in importance as forage was fringed sagewort *(Artemisia frigida)*. Grasses were utilized very little in the fall and winter.

Upland Game Birds

As the name implies, sagebrush is very important for daily and seasonal activities for the sage grouse *(Centrocercus urophasianus)*. This bird is associated with continuous sagebrush vegetation type, big sage being the key species. Big sage provides most of the sage grouse's diet during the year (100% of its diet during the winter months). A variety of plants and some animal matter are included in the summer diet. Known strutting grounds are shown on the Wildlife-Fish Habitat (Existing) Map, but more studies are needed to identify all strutting sites.

Sharp-tail grouse *(Pedioecetes phasianellus)* habitat is the grassland and pine-grassland. Sharp-tails occupy drainages and open cultivated fields during late summer or fall. Grass is important for nesting cover, escape cover, and brood cover, with "nesting cover especially critical around dancing grounds during the mating season" (Fish and Game, 1973). Known sharp-tail areas are shown on the Wildlife-Fish Habitat (Existing) Map.

Pheasants *(Phaslanus colchicus)* occur along the drainages of Armell's Creek, Rosebud Creek, and the Yellowstone River (Map: Wildlife-Fish Habitat (Existing)).

Hungarian partridge *(Perdix perdix)* habitat is closely associated with pheasant and sharp-tail grouse habitats. As with the pheasant and sharp-tail, the combination of noncultivated and cultivated lands provides optimum habitat.

The wild turkey *(Meleagris gallopavo)* habitat is the rough terrain areas associated with ponderosa pine-grassland type. Turkeys (Jonas, 1966) utilize the grasslands adjacent to ponderosa pine, especially in the spring, summer and fall. In the winter they use the deciduous tree-brush communities along the drainage ways more than other vegetation types. Their diet consists mainly of seeds, fruits, berries, and leaves during the fall, winter and spring. If available, ponderosa pine seed and insects are important and preferred in the spring and summer. Domestic grain fields and farm yards provide feeding grounds and protection during fall and winter months. In general, turkey populations are stable or increasing in the study area.

Waterfowl

The study area is in the central flyway, and migratory waterfowl observed in the area include mallard *(Anas platyrhynchos)*, green-winged teal *(Anas carolinesis)*, and blue-winged teal *(Anas discors)* (Ecological Consulting, 1973). Canadian geese (*Branta canadensis*) nest along the Yellowstone River in spring, especially on the small islands in the river (Hainz, 1973). There are no resident waterfowl in the study area except for a few puddle ducks in the streams and stock water reservoirs. Some geese and migratory ducks may nest on the stock water reservoirs (Map: Wildlife-Fish Habitat (Existing)) in the spring.

Furbearers

Important furbearers in the study area are mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), and beaver (*Castor canadensis*). Mink, which feed on birds, eggs, frogs, crayfish, and fish, are found along aquatic habitats such as the Yellowstone River, Armell's Creek and Rosebud Creek. Muskrat and beaver inhabit perennial waterways and eat aquatic vegetation such as cattails (*Tsuga spp.*), rushes (*Juncus spp.*), and water lilies (*Nuphar polysepalum*). Muskrats also eat frogs and fish occasionally (Burt and Grossheider, 1964). Other furbearers include bobcats (*Lynx rufus*), coyotes (*Canis latrans*), raccoon (*Procyon lotor*), badger (*Taxidea taxus*), and red fox (*Vulpes vulpes*).

Predators

The major mammalian predators in the study area are badger, raccoon, red fox, coyote, bobcat, long-tailed weasel (*Mustela frenata*), and striped skunk (*Mephitis mephitis*).

Peregrine falcons (*Falco peregrinus*) are occasionally observed along the Yellowstone River and near the mouth of Armell's Creek in the winter time. Populations of peregrine falcon have been reduced to dangerously low numbers because of disturbance to nesting sites, human harassment, and pesticides. Prairie falcon (Falco mexicanus) have nesting sites along the cliffs bordering the Yellowstone River.

Rare and Endangered Species

The presence of the rare black-footed ferret (Mustela nigripes) is directly related to the occurence of black-tailed prairie dog colonies. Although one colony of black-tailed prairie dogs has been reported in the study area, no black-footed ferrets have been sighted. More research needs to be done to establish the status of this species in the study area. The peregrine falcon is also on the endangered species list.

Small Mammals

There are approximately 25-30 species of small mammals found in the study area. They are listed in Appendix A.

Birds

Bald eagles (Haliaeetus leucocephalus) and golden eagles (Aquila chrysaetos) have been observed along the Yellowstone River. The number of bald eagles observed in the fall has been increasing over the past years and is being studied by the Montana Department of Fish and Game. Song birds, hawks, and owls are listed by seasonal occurrence and abundance in Appendix B.

5.1.3.2 Fisheries

The main fisheries population to be affected by this project is in the Yellowstone River. The species composition of the river in the vicinity of the diversion is presently under study and to date there have been no complete or nearly complete species lists made available. These studies, initiated in the summer of 1973, will continue through 1974 and the first reasonably comprehensive species list will be available at that time. However, it must be acknowledged that species lists have little, if any, meaning other than an indication of what individuals occur in the river's fish population. Until population data is available on at least some of these species and the life histories of the major species understood in the Yellowstone River, the impact of water withdrawal cannot be realistically assessed. Superficial observations made to date indicate that goldeye is the most abundant species available during the sampling periods in the vicinity of Nichols. There is also a sport fishery for paddlefish from Forsyth downstream to below the Intake diversion near Glendive, Montana. Previous studies indicate that this fishery is dependent upon a migratory population of paddlefish from Garrison Reservoir that extends through the area in question, presumably to spawning grounds in the Yellowstone River. Sport fisheries are also directed at sauger (*Stizostedion canadense*), sturgeon (*Scaphlrhynchus platorynchus*) and burbot (*Lota lota*).

As with any species, these fish populations are dependent upon the continued maintenance of their aquatic habitat, both quantitatively and qualitatively. Armell's Creek is an intermittent stream and little is understood of the aquatic and amphibious communities that it supports. It is known that a sport fishery occurs during the spring at the mouth of this creek, which is directed primarily at channel catfish (Ictalurus punctatus). The residual pools, while not of any great value for sport fishing purposes, probably support a variety of life forms. These would be fish species trapped, and perhaps surviving in the intermittent pools, amphibians, reptiles, and invertebrate communities. Stock water reservoirs in the study area have in some cases been stocked with suitable fish species, and some of these populations may have become self-sustaining. Others are dependent upon artificial restocking (Map: Wildlife-Fish Habitat (Existing).

5.1.4 Geology

5.1.4.1 Physiography

The study area is within what Fenneman (1971) describes as the Missouri Plateau which in turn is a division of the Great Plains Province. Other authors refer to the structural and sedimentary basins in which Colstrip is located as the Powder River Basin and the Fort Union Region. Kepferle (1954) describes Rosebud County as being part of the Fort Union-Powder River Region.

The Fort Union formation which contains the coal deposits of this study area extends from the eastern flanks of the Beartooth and Crazy Mountains to east of the North Dakota-Montana border. At present, this formation occurs in the Montana portion of the Bighorn Basin near Red Lodge, in the Bull Mountains near Roundup, and over a large portion of eastern Montana and extends into Wyoming, South Dakota, North Dakota and Canada. The area where the Fort Union Formation is in the bedrock is known as the Fort Union Region (Ayler, et. al. 1969).

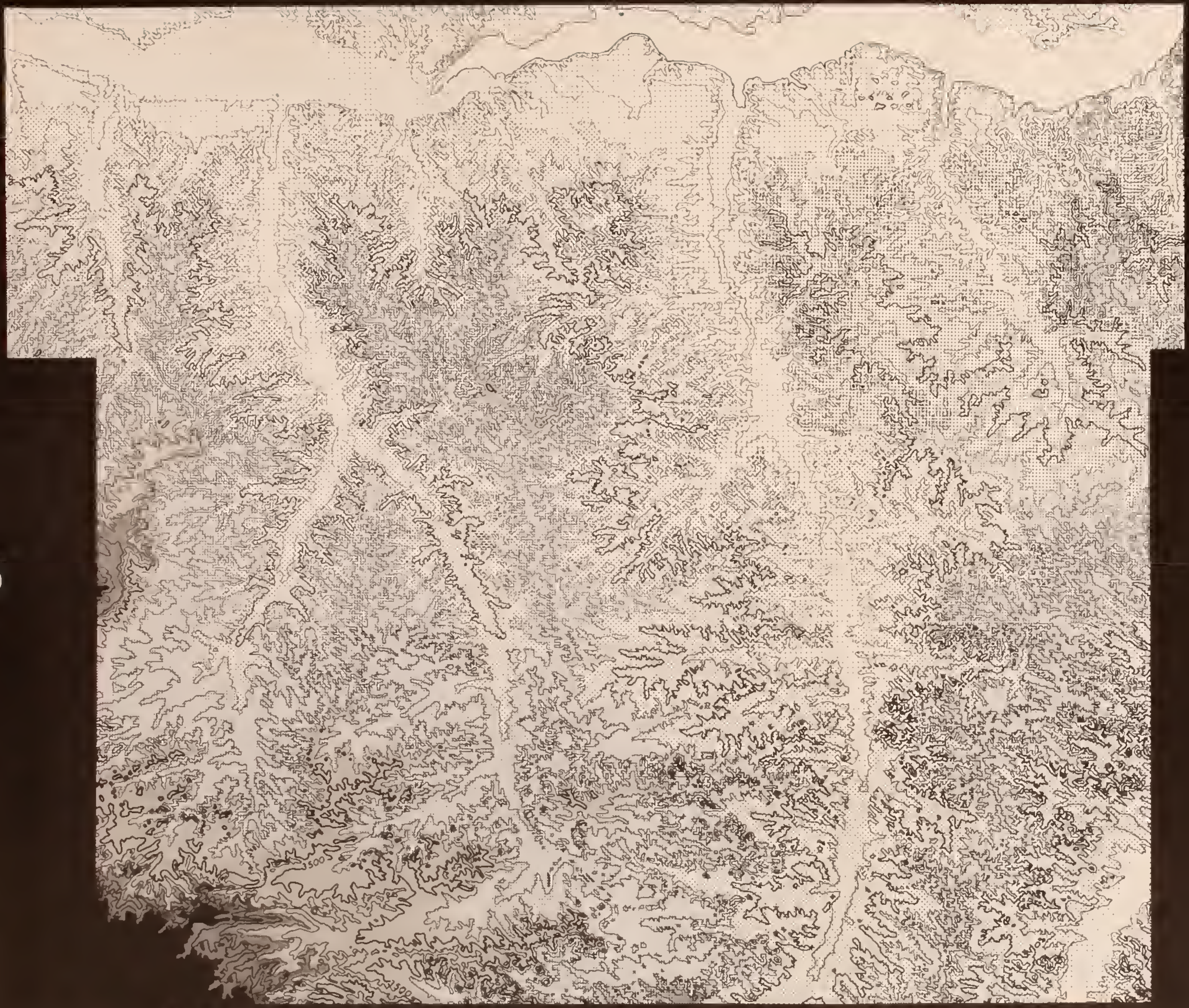
A structural low occurs between the Black Hills uplift and the Bighorn Mountains which is known as the Powder River Basin. This feature is structural and is different from the drainage basin of the Powder River. The Powder River Basin contains large amounts of coal in both Montana and Wyoming.

Although the study area lies within the unglaciated Great Plains, the area has considerable relief. The terrain can be divided into two valleys and floodplains of the major streams and the uplands comprising the divides between these streams (Map: Topography).

The study area is drained entirely by the Yellowstone River which runs along the northern edge. Major streams within the area are Armell's Creek, Rosebud Creek, and the Tongue River. Several smaller streams drain the area in the vicinity of the Yellowstone River.

Another geomorphic feature of the area, included in the uplands, are the terraces of older streams. Terrace gravels have been mapped more than 1,000 feet above the present Yellowstone River (Dobbin, 1929). Lower terraces exist along the sides of the Yellowstone River. The ages of the terraces are uncertain, though some of the lower ones are most likely Pleistocene and the higher ones may be Pliocene or Miocene in age (Dobbin, 1929 and Pierce, 1936).

Elevations in the study area range from 2,435 feet at the Yellowstone River in the NE corner of the area to about 4,800 feet in the Wolf Mountains near the SW corner of the area, a difference of almost 2,400 feet. The local relief, though, seldom exceeds 300 feet.



COLSTRIP UNITS 1 & 2 ASSOC. FACILITIES - WATER SUPPLY & 115 KV LINE

TOPOGRAPHY

LEGEND
- ☐ 2500 & BELOW
- ☐ 2500-2800
- ▨ 2800-3100
- ▨ 3100-3400
- ▨ 3400-3700
- ▨ 3700-4000
- ■ 4000 & ABOVE

SOURCE
ARMY MAP SERVICE 1966

ENERGY PLANNING DIV., DNR & C, HELENA, MT. SCALE: 1/2" = 1 MI.

Along the divides between these streams lie the dissected uplands. The Wolf Mountains rise more than 1000 feet above the other uplands in the area. In the vicinity of Colstrip the highest elevations are slightly greater than 3,500 feet. Between Armell's Creek and Rosebud Creek the uplands rise to about 3,500 feet but along the Rosebud Creek - Tongue River divide, maximum elevations are only about 3,200 to 3,300 feet.

The character of the uplands is that of a dissected plateau. The nearly flat-lying sedimentary rocks reflect the differences in resistance of the different strata. Resistant sandstone and clinker beds support high-standing flat areas (plateaus and buttes) and form a variety of smaller-scale landforms. Isolated hills and knobs composed of sandstone or clinker, some with rather interesting shapes and forms, are common in many parts of the area.

The Yellowstone River floodplain is as much as two miles wide. Within four to eight miles of the south side of the river, the valley is bordered by the gravel-covered terraces which rise in step-like fashion to the summits of the uplands. Except that of the Yellowstone River, the floodplains in the study area are narrow and generally poorly developed.

5.1.4.2 Stratigraphy

All rocks exposed in the study area are of sedimentary origin ranging in age from Upper Cretaceous to Recent (100 million years ago to present). The Judith River formation is the oldest stratigraphic unit exposed in the study area. The areal extent of this formation in the study area is limited to about a square mile in the northwest corner, on the sides of the Yellowstone River

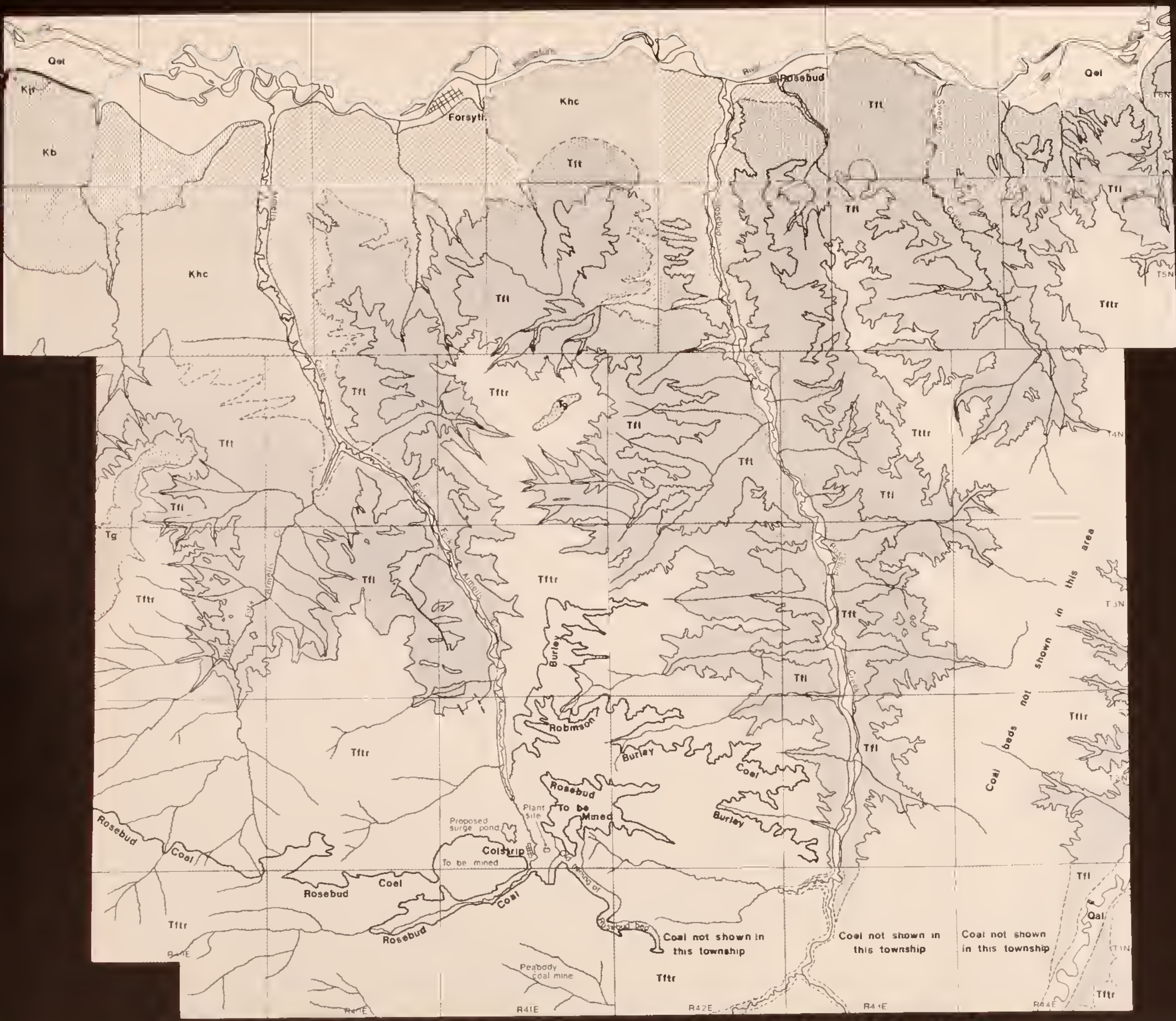
floodplain. The Bearpaw shale is similarly restricted in its areal extent in the study area to the northwest corner. The youngest of the Cretaceous formations is the Hell Creek which is exposed along the Yellowstone River as far east as the town of Rosebud. Armell's Creek and Rosebud Creek have cut through the overlying sediments exposing the Hell Creek formation along their lower portion. The Fort Union formation covers the remainder of the study area at the surface except in areas where it is covered by alluvium or terrace deposits (Map: Geology).

Judith River Formation

The Judith River formation is part of the Montana Group of Upper Cretaceous deposits in southeastern Montana (Fig. 10). The top of this formation is composed of about 20 feet of hard grayish-white sandstone which is more resistant than adjacent strata. Beneath the sandstone, the formation consists of a brown sandy shale. Fossilized marine invertebrates are evidence for a marine origin of these rocks (Dobbin, 1929).

Bearpaw Shale

This formation is composed mostly of a dark gray to chocolate-colored fossil marine shale. The formation is about 950 feet thick. At the top of this interval is a transitional zone 20 to 60 feet thick (Dobbin, 1929 and Renick, 1929). which is believed to be the last marine sediments in Montana (Dobbin, 1929). The shale contains abundant calcareous concretions some of which contain marine invertebrate fossils (Dobbin, 1929).



COLSTRIP UNITS 1&2 ASSOC. FACILITIES - WATER SUPPLY & [illegible] KV LINE

GEOLOGY

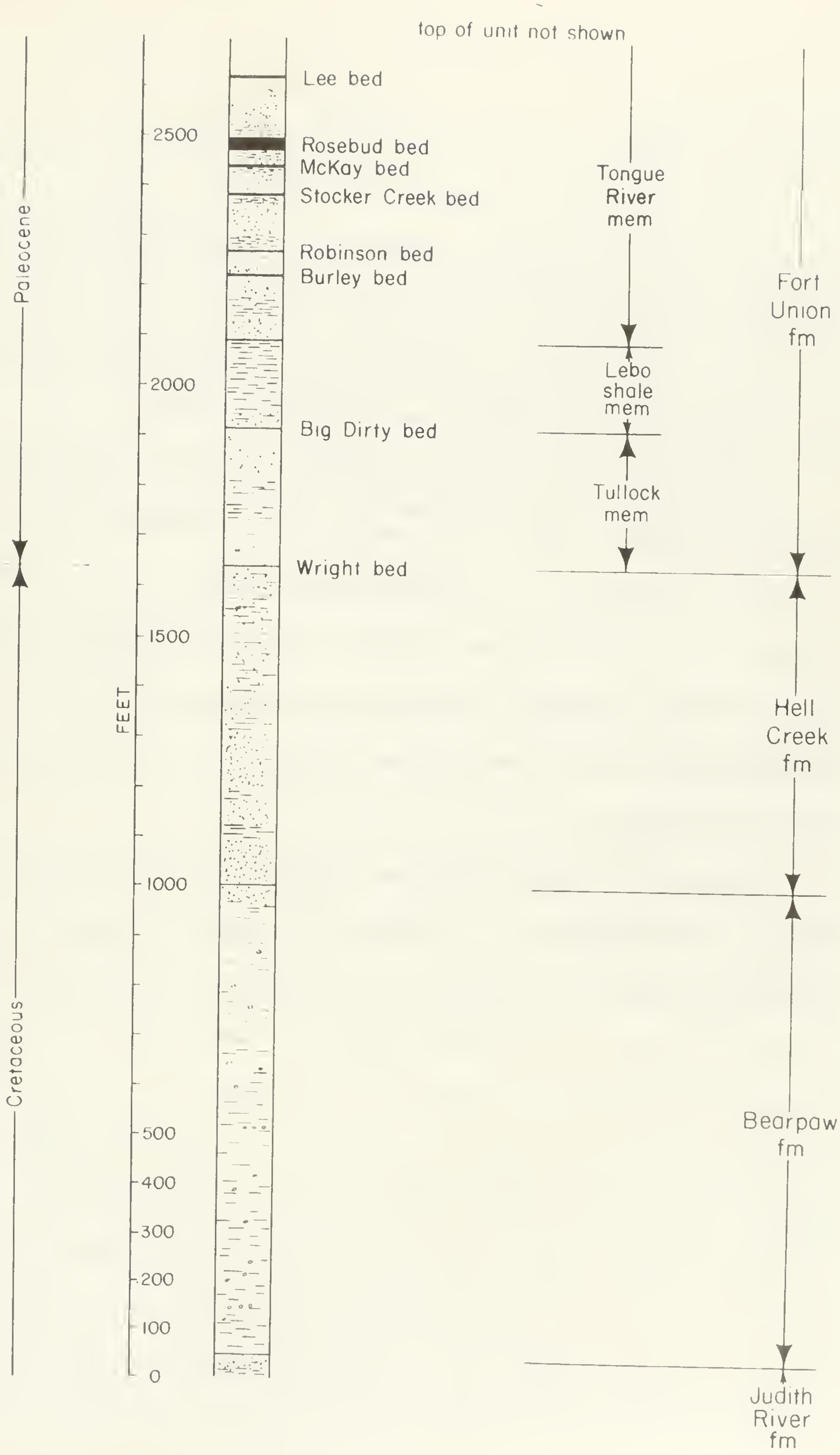
NOTE: No attempt was made to resolve difference between maps which occur between R 41E and R 42E. Extensive gravel deposits mapped by Pierce are not shown on this map. Only coal beds of importance to this project are shown.

LEGEND

- Qal Alluvium
- Tg High Level Terrace Gravels (west half only)
- Tftr Fort Union Fm Tongue River mem
- Tfl Fort Union Fm Lebo Shale mem
- Tft Fort Union Fm Tullock mem
- Khc Hell Creek Fm
- Kb Bearpaw Fm
- ■ Judith River
- Limit of Coal Bed (Name of bed shown on side underlain by coal)
- Fault Line

Sources:
Dobbin 1929, Pierce 1936
and Renick 1929

ENERGY PLANNING DIV., DNR&C, HELENA, MT. SCALE 1/2"=1 MI.



GENERALIZED STRATIGRAPHIC COLUMN OF STUDY AREA

Figure 10

Hell Creek Formation

The term Hell Creek was once applied as the name of a member of the Lance formation. The Lance was considered to be Tertiary in age and was divided into the Hell Creek and Tullock members (Dobbin, 1929). The name "Lance" is little used at present in Montana and the Hell Creek unit is considered to be a separate formation of Cretaceous age (Kepferle, 1954).

The Hell Creek lies conformably on the Bearpaw shale and no sharp contact exists (Dobbin, 1929). In the study area, the Hell Creek is about 636 feet thick. Grayish-brown, cross-bedded sandstone beds, some more than 50 feet thick, occur in this formation. Somber-colored clay and shale also occur in the Hell Creek in the study area but not as abundantly as at the type section in Garfield County. These shales are less yellow in color than the overlying Fort Union sediments.

Areas where the Hell Creek crops out tend to be rugged and access difficult. A few badlands occur along Armell's Creek and other streams in the study area and some unique forms are produced by wind erosion in some of the beds in this unit. Cross-bedded conglomerate layers in the lower part of the unit contain pebbles more than an inch in diameter. These conglomerates suggest the presence of stronger currents than those which deposited the upper portions of the formation (Dobbin, 1929). The upper part of the unit is composed mostly of light-colored sandy shale with lenses of sandstone and some concretionary beds. The top of the Hell Creek is drawn at the Wright coal bed. Except for the Wright coal, the contact between the Hell Creek and

Fort Union formations would be difficult to establish.

Fort Union Formation

Above the Wright coal bed, there is a sequence of sandstones, shale, clay, and coal of Paleocene age referred to as the Fort Union formation. Three members are recognized within the formation which are the Tullock, Lebo shale, and the Tongue River. The Tullock member was once included in the Lance formation. The Fort Union attains a thickness of about 2,175 feet in Rosebud County (Kepferle, 1954).

Tullock Member

The Tullock member consists of the yellowish-gray sandstone, sandy shale, and thin coal beds between the Wright coal bed at its base and the Big Dirty coal bed or a resistant, calcareous, sandstone rimrock at the top. In places where neither the Big Dirty coal nor the sandstone bed is present, the contact between the Tullock member and the overlying Lebo shale is indefinite. The thickness of this member is 240 to 300 feet in the study area (Kepferle, 1954).

Lebo Shale Member

The Lebo shale is composed of dark gray to black clay and shale, concretion zones, and several thin coal beds. In places non-persistent sandstone lenses occur. The thickness of this member ranges from 105 feet to about 220 feet in the study area, averaging about 170 feet (Kepferle, 1954). In valleys where it crops out, this member tends to form badlands and supports little vegetaion.

Tongue River Member

The uppermost portion of the Fort Union formation is the Tongue River member. The base of the Tongue River is marked by a transition zone of sandy shale to the predominantly light colored sandstone and shale that distinguish this member from the lower ones. Although the top of this member has been eroded away, about 1,600 feet of it remain near the southern edge of the study area (Kepferle, 1954).

This member contains sandstone, shale, carbonaceous shale, some thin fresh-water limestone beds, and coal. Several of the coal beds are thick enough to be mined. Much of the coal has burned in situ, especially near the outcrops of the thicker seams. The heat of the burning coal was sufficiently high to fuse and alter the overlying sediments, generally causing them to have a pink or red color and a fractured, rubbly appearance. The terms "scoria" and "clinker" are used to identify this material. The baking and partial fusion of the shales and sandstones result in a more resistant material. Topographic highs are often capped by clinker.

Terrace Gravels and Alluvium

As many as 13 different levels of terrace gravels up to 70 feet thick lie along the Yellowstone River in the study area. These gravels are thought to be from Oligocene to Recent in age (Kepferle, 1954). They contain boulders up to a foot in diameter, though most are one to four inches, and are igneous rocks, quartzite, limestone, and clinker. In places, the gravels are cemented. The highest of these deposits are 1,000 to 1,100 feet above the present level of the Yellowstone River. One such high level deposit within the study area lies in T3N, R39E and T4N, R39E more than 1,000 feet above the Yellowstone River. Other deposits also occur about 700 feet above the river in T5N, R41E and T5N, R44E which are thought to be Miocene or Pliocene in age (Kepferle, 1954). Younger terrace deposits also occur along the Yellowstone.

The floodplains of the Yellowstone River and the major streams in the study area are generally covered by alluvium. This alluvium is mostly silt, clay, and sand, with some gravel in varying amounts.

5.1.4.3 Structure

The study area lies in a broad shallow syncline between the Big Horn uplift to the west, the Porcupine uplift to the north, and the Black Hills uplift farther to the east. Over most of the area the beds are essentially flat-lying with dips of about one degree or less. The greatest dip is in the northwest corner of the study area where the dip is south about three degrees in the area where the Judith River and Bearpaw formations crop out. This dip is a reflection of the Porcupine uplift. However, the regional dip in the entire study area is to the south (Dobbin, 1929).

Minor flextures of the beds do occur throughout the basin; however, these are gentle folds and do not cause significant dips (Dobbin, 1929). Some minor differences in the elevations of coal beds could be the result of differential compaction. Thick coal beds, such as those occuring in the Fort Union formation, are derived from much greater thicknesses of organic material originally deposited. A stratum, originally horizontal, overlying a thick coal seam in one area and another rock type in another area would likely be warped by the greater compaction of the coal.

Some minor faults also exist in the study area. Dobbin (1929) refers to these faults as being normal with displacement of about 60 feet occurring in T3N, R40E and T3N, R41E. Other small faults have been mapped by the USGS to the west of Colstrip in an area to be mined. Again, these faults are minor structures. Pierce (1936) suggests that these faults may be due to differential compaction of the underlying sediments.

5.1.4.4 Economic Geology

Coal

The subbituminous and lignite deposits of Montana, Wyoming, and the Dakotas represent one of the largest coal deposits in the world. Although the coal within the study area is but a small fraction of the deposits in the four-state area, it is the study area's most important economic mineral commodity. This situation is likely to remain the case for some time unless major new discoveries of other minerals are made or coal should lose its present economic status. However, the recent shortages of petroleum products, the hazards of the dependence upon foreign sources of oil, and the recent changes in federal policy regarding increased reliance upon coal will, no doubt, increase the value of Montana coal for many years to come.

Although numerous coal beds exist in the older units, the Tongue River member of the Fort Union formation contains the only economically valuable coals. The Wright bed occurs at the base of the Tullock member of the Fort Union formation. This coal has been mined in the past to supply local needs in Forsyth (Dobbin, 1929). In places where it was mined, this bed ranges from three to four feet in thickness. Along Armell's Creek it ranges from a foot or less to about three feet, and in places it splits into two seams a number of feet apart (Dobbin, 1929).

The Hambre bed occurs about 200 feet above the Wright in the Tullock member and consists of an average of three feet of coal, carbonaceous shale, and carbonaceous sandstone.

The Lebo shale member contains the Big Dirty bed at its base. The Big Dirty bed ranges in thickness from 3 to 13 feet and usually consists of only a small amount of clean coal. Along the East Fork of Armell's Creek the bed contains 6 to 11 feet of fair grade coal but this amount is unusual (Dobbin, 1929).

The Wright, Hambre, Big Dirty, and other smaller beds occurring in the Tullock and Lebo shale member are not economical coal deposits by today's standards.

In the western half of the study area, the Burley bed occurs about 130 feet above the base of the Tongue River member and is the lowest of the valuable coals. In Section 24, T3N, R41E, this seam contains about five feet of coal. A maximum measured thickness for this bed is 9-1/2 feet in T4N, R44E (Pierce, 1936). The thickness of the Burley bed is variable, though, and is less than two feet thick in T3N, R44E, the township adjacent to the one with the greatest thickness. North of Colstrip along the East Fork of Armell's Creek the average thickness is about four feet (Dobbin, 1929). The Burley bed constitutes a potentially economical resource in the area north and northeast of Colstrip, although the Department knows of no plans to mine this bed.

The Robinson bed lies about 43 feet above the Burley in the vicinity of Colstrip. East of the East Fork of Armell's Creek in T2N, R41E, the bed is 2-1/2 to 4-1/2 feet thick but thickens to about 8 feet in T2N, R41E (Dobbin, 1929). In the Rosebud coal field (east of R41E), the Turret bed occurs at about the same horizon as the Robinson bed. The Turret thickens to the east from less than 18 inches west of Rosebud Creek to an average of 12 feet along the Rosebud-Tongue River Divide (Pierce, 1936).

West of Colstrip, the Stocker Creek bed crops out about 130 feet above the Robinson bed. This bed is about 6 feet thick in T2N, R40E. A maximum thickness of this bed was reported by Dobbin (1929) to be 9 feet just west of the study area.

The McKay and Rosebud seams are the most economically valuable coal beds within the study area. The Western Energy Mine at Colstrip mined some 5.5 million tons in 1972 from the Rosebud bed. The Peabody mine south of Colstrip mined a total of 1.6 million tons from both seams during 1972. Coal from McKay and Rosebud seams is sold to eastern utility companies and is burned in the Correte Plant in Billings. Units 1 & 2 at Colstrip will also be fired using the coal from the Rosebud seam. If Units 3 & 4 are built, they too will be supplied from the Western

Energy mine. The company plans to extend the mine to exploit the Rosebud bed to the northeast, southwest, and west of the town of Colstrip. Production from this mine is expected to reach 19.3 million tons per year by 1980. (For comparison, the largest coal mine in the U.S. had a projected production of 8.5 million tons for 1973.)

The Rosebud bed is the thickest and most widespread coal seam in the study area. It lies about 360 feet above the base of the Tongue River member (Dobbin, 1929, Kepferle, 1954). The limits of this coal bed are shown on the geologic map in this report. Kepferle (1954) shows an isopach (thickness contour) map of the Rosebud bed. This seam is thickest southeast of the town of Colstrip -- in excess of 25 feet. The thickness of the seam along its boundary west of Colstrip is about 20 feet, and along the south edge and the southwest corner of the study area the thickness is about 10 feet.

The McKay bed is thinner and apparently more variable than the Rosebud, and in the Western Energy mine it occurs about 10 to 18 feet below the Rosebud where it is about 8 to 9 feet thick (Kepferle, 1954).

Several other coal beds lie above the Rosebud but have much less economic importance than the Rosebud within the study area. These beds occur south of the proposed mine in the Rosebud seam.

Many of the thicker coal beds have burned along their outcrops. This burning had mostly occurred prior to the arrival of the white man in this area and is presumed to have been caused by wild fires, lightning, and other natural causes. The process of natural underground coal fires is not well understood, but the burning eventually stops at some point from the original outcrop, possibly when oxygen cannot get to the combustion zone. The heat released during combustion physically (and chemically) alters the sedimentary rocks around the coal, especially above the burned seam. The thermally metamorphosed rocks generally have an orange or red color and are called "scoria" or "clinker". Parts of this clinker show that the material was fluid at one point in its history, but the greatest amount was never fluid and the sedimentary texture still exists. Clinker is a brittle, highly fractured rock which is more resistant to erosion than most of the unaltered rock. Within the area of the thicker coal beds, much of the surface is capped by clinker and some of the landforms are the result of this material.

The coals in the study area are subbituminous and are generally low in sulfur. The Rosebud coal for use in Units 1 & 2 of the Colstrip generating plant is reported to have the following average properties:

BTU/lb (as received -- 8843

moisture -- 23.9%

sulfur -- 0.77%

ash -- 8.59%

(HES, March, 1973)

Clinker

The clinker which occurs in the study area is used locally for railroad ballast and road surfacing material. Small quarries are worked from time to time to extract this material when needed.

5.1.4.5 Surface Water

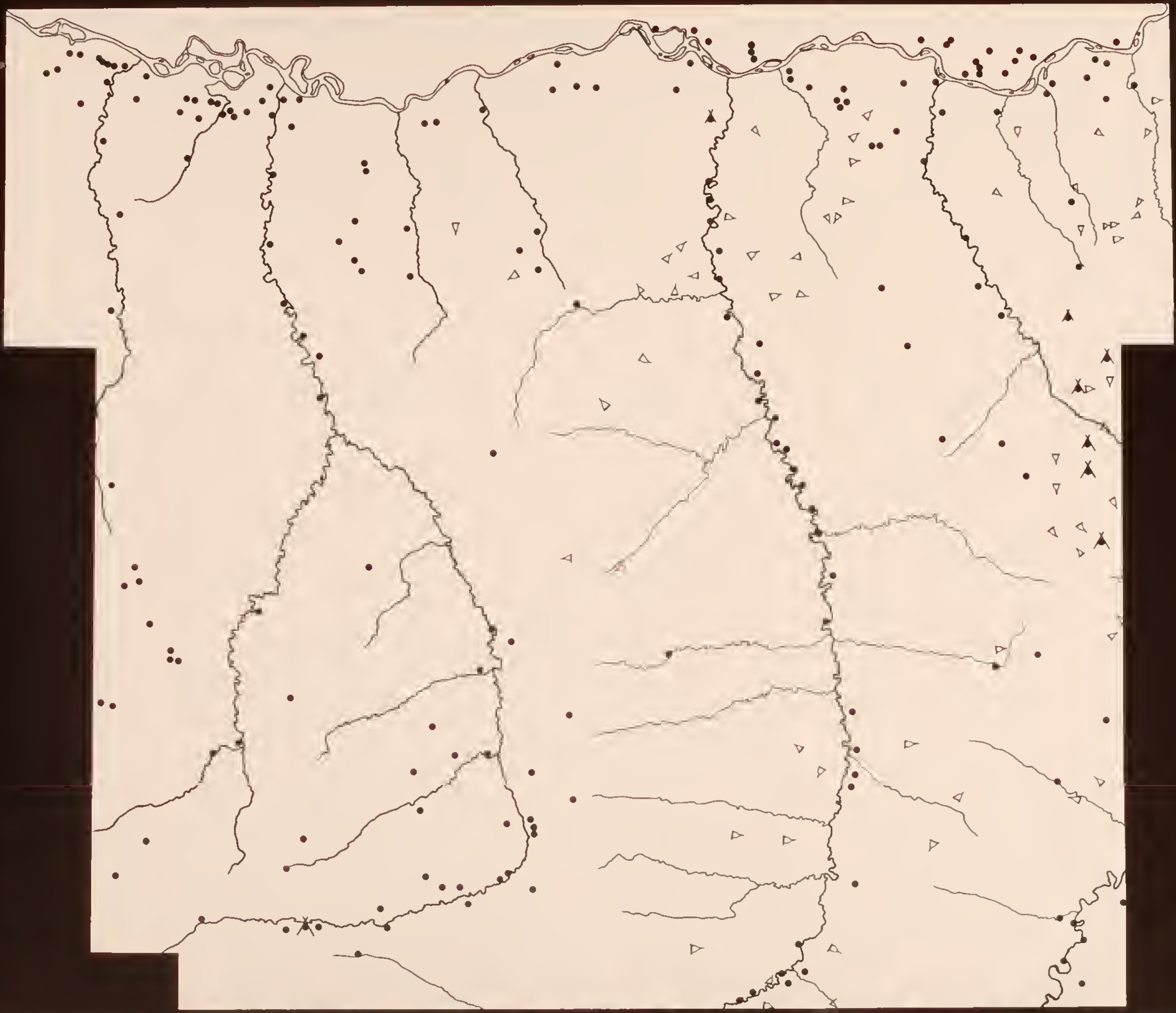
The entire study area is drained by the Yellowstone River and its tributaries. The Yellowstone flows from west to east along the northern edge of the area. Tributaries of the Yellowstone within the area are Armell's Creek, Rosebud Creek, the Tongue River, and several smaller streams. Only the Yellowstone River, Tongue River, and a portion of Rosebud Creek are perenial streams; all others being intermittent. The intermittent streams usually flow only in the spring and early summer.

There does not exist within the study area any significant wetlands or natural lakes, but a number of small impoundments have been built for use by the ranchers (Map: Water Development). These ponds are used mostly for stock watering. The typical pond consists of an earth dam across a gully which catches and holds the spring runoff and seldom exceeds a few acres.

Water spreading dikes are used along Armell's Creek to slow the movement of the runoff water. These dikes cause flooding of the fields so that the soils becomes well watered. This water in the soil is then available for plant growth later in the season.

The Yellowstone River drains an area of more than 68,000 square miles in southern Montana and northern and central Wyoming. Major tributaries include the Bighorn, Tongue, and Powder Rivers. Some eight to ten million acre-feet of water flows down the Yellowstone in a typical year. However, the flow is not uniformly distributed throughout the year. The greatest flows occur in May, June, and July and the lowest flows are in late summer and winter.

The following table gives flow values for selected points on the Yellow-



COLSTRIP UNITS 1&2 ASSOC. FACILITIES - WATER SUPPLY & 115 KV LINE

WATER DEVELOPMENT

LEGEND
- ● WELL (WITH PUMP)
- Ⲁ WELL (WITH WINDMILL)
- ◁ RESERVOIR (2 ACRE MIN.)

SOURCE:
BLM 1972

ENERGY PLANNING DIV. DNR&C, HELENA, MT. SCALE 1/2"=1 MI.

stone and its tributaries.

STATION	DRAINAGE AREA, Mi2	MAX. FLOW cfs	MIN. FLOW cfs	AVG. FLOW cfs
Yellowstone at Billings	11,795	66,100	430	6,858
Bighorn at Bighorn	22,885	26,200	275	3,851
Tongue at Miles City	5,379	13.300	0	423
Yellowstone at Miles City	48,253	96,300	996	11,330
Powder near Locate	13,194	31,000	0	620
Yellowstone near Sidney	69,103	159,000	470	13,030

(Water Records of 1972, 1973)

Only poor records for a short period of time exist for the Yellowstone at Forsyth, but flow estimates can be made by using other gaging points. The flow at Forsyth is approximately the flow value at Miles City minus the flow of the Tongue at that station.

It must be pointed out that the minimum and maximum flow values are historical and not necessarily subject to occuring again, mostly because of regulation of the Bighorn by Yellowstone Dam (beginning November, 1965). The average discharge from this dam is in the order of 3000 - 5000 cfs (with a minimum not less than 1000 cfs) which evens the flow of the Bighorn into the Yellowstone. Considering the discharge from this dam, minimum flows at Forsyth could be expected to be 2000 cfs or more in the future even though the historical low in about 990 cfs. Even though the flow may be as low as 2000 cfs, that flow should be only a temporary condition.

5.1.4.6 Groundwater

Water is a critical factor in the maintenance of growth of agricultural or industrial activities in the semi-arid region of which this study is a part. Primarily, water is obtained from either streams and impoundments or wells. Therefore, within the study area, groundwater is a valuable resource. The town of Colstrip uses wells for its municipal water supply and other inhabitants use groundwater for domestic purposes and for livestock watering. Any significant change of either quantity or quality of the groundwater has the potential for affecting the inhabitants of the area.

Sandstone, coal beds, and clinker beds are the main types of shallow aquifers in the vicinity. Shale and clay beds tend to restrict groundwater flow and, thus, play an important role in the groundwater system. Because the aquifers recharge in certain areas and discharge in other areas, the groundwater system is a dynamic one responding to changes in weather and those generated by man. The shallow aquifers tend to be strongly affected by the topography. Thus, the groundwater systems in these units are commonly local but may yield useful amounts of water for local uses. The deeper aquifers of Mesozoic and Paleozoic age underlie the area and these systems are of a regional scale which involve geologic features found well outside of the study area (Black Hills of South Dakota and the Bighorn Mountains).

In considering groundwater resources, the quality of the water is important. Within the study area, the groundwater quality varies from water which is quite good to water that is useless for most purposes. A number of substances are generally found dissolved in groundwater. These are the metals sodium (Na), magnesium (Mg), calcium (Ca), iron (Fe), manganese

(Mn), potassium (K), and the anions bicarbonate (HCO_3), carbonate (CO_3), sulfate (SO_4), chloride (C_1), fluoride (F), nitrate (NO_3), and phosphate (PO_4). Trace amounts of a number of other substances also occur in groundwater. When any or a combination of these substances are too concentrated, the water becomes unsuitable for certain uses.

Major Shallow Aquifers Within Study Area

Sandstones of the Judith River formation yield good water if the well does not penetrate the overlying shale. Water that has percolated through a younger shale unit is often unfit for drinking or irrigation and sometimes unfit for livestock watering (Renick, 1929).

The Bearpaw shale is a poor aquifer and generally yields only small amounts of highly mineralized water unfit for most purposes.

Sandstones of the Hell Creek formation often yield useful quantities of water satisfactory for some uses. Up to 100 gallons per minute (0.223 cfs) may be expected from some wells in this unit (Renick, 1929).

The Fort Union formation contains a number of aquifers in the Tullock and Tongue River members but few of significance in the Lebo shale. In the Tongue River member, thick coal beds and clinker beds constitute useful aquifers as do some of the sandstones. Water from the Tongue River member is mineralized but not to the extent that water from some other formation is. Near-surface water, in general, is harder than deeper water from the same member (Renick, 1929). Some of the water in the coal beds is of better quality than that from the enclosing rocks. On the other hand, water found in clinker is often quite hard (Renick, 1929).

Within the study area, water found in the terrace gravels near the Yellowstone River is some of the best, although this water is considered hard. Alluvium along the Yellowstone and Tongue Rivers yields water within a depth of a only a few tens of feet. The quality of the water in the alluvium depends upon its source which is often another local aquifer (Renick, 1929).

Although these shallow aquifers provide water for local uses at this time, a large supply for extensive irrigation or industrial use is not available from this source. Colstrip is supplied with water by four shallow wells (350 to 1000 feet deep). Each well produces up to 40 GPM (0.09 cfs). Many other wells produce less than 20 GPM from aquifers 20-350 feet deep. At 40 GPM 200 wells would be needed to provide the water necessary for operating power plant Units 1 and 2. Providing aquifers with sufficient yield were found and the water quality were satisfactory, Montana Power Company estimates that the drilling of these wells would cost five million dollars. The construction of the pipelines and associated equipment and the effects of this water use would add greatly to the economic and environmental costs.

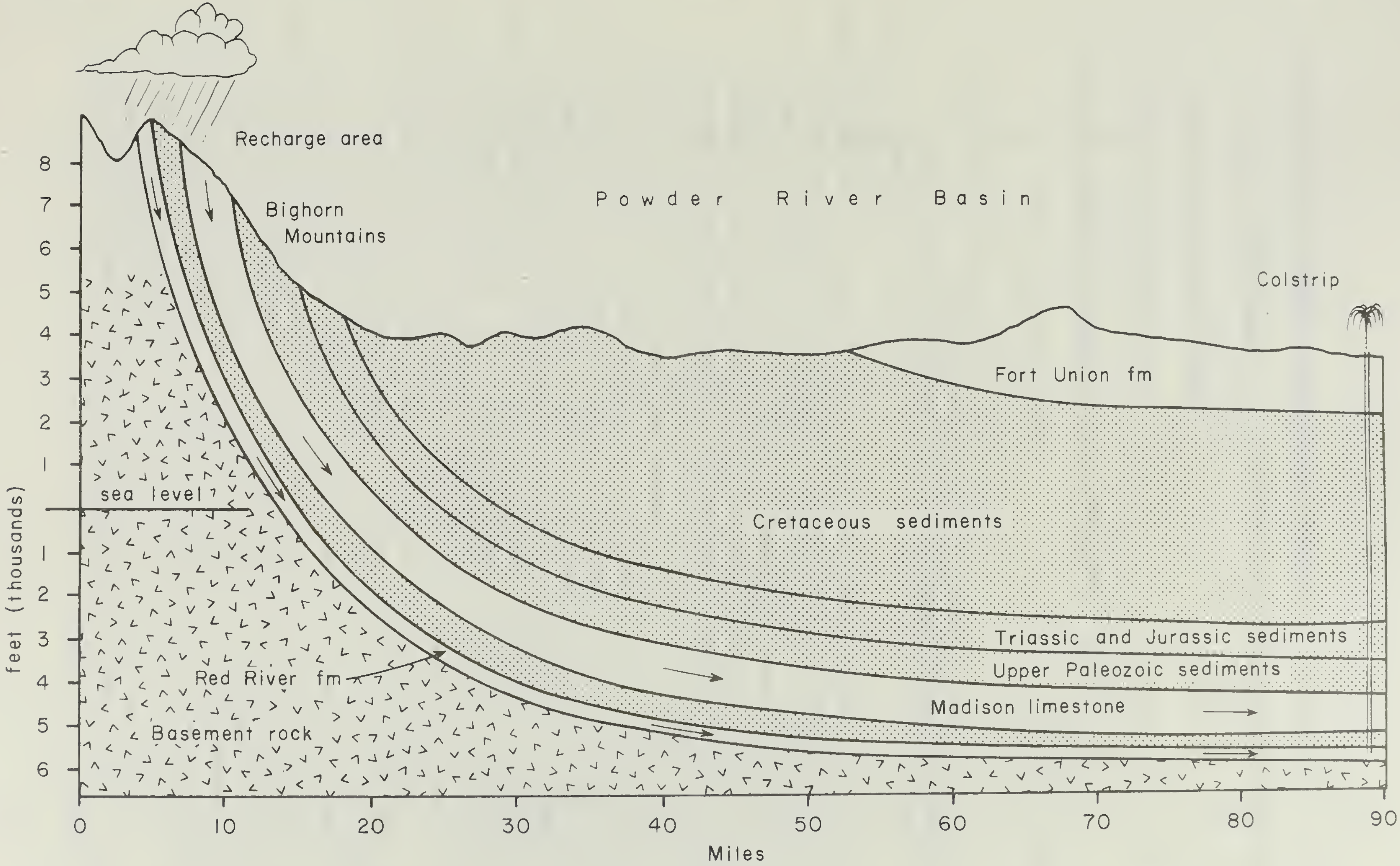
Deep Aquifers

From oil drilling operations in the Powder River Basin, it was known that certain deeply buried formations are aquifers. One well in the Bell Creek oil field, in southeastern Powder River County, is reported to yield 30,000 barrels per day (1.26 X 106 gallons/day or 2 cfs). Montana Power Company had a well drilled at Colstrip to determine the feasibility of using deep groundwater for the generating plant. This well penetrated the Winnipeg formation (Ordovician) and reached a total depth of 9,336 feet. This well passed through three formations which provided water. These formations were the Mission Canyon, (Madison Group, Mississipian) at 7,796 feet, Lodgepole (Madison Group, Mississipian) at 8,340 feet, and the Red River (Ordovician). The Red River formation is equivalent to the Bighorn dolomite. Both the Madison limestone and the Bighorn dolomite crop out in the Bighorn Mountains some 80 miles to the southwest of Colstrip (Fig. 11). The Madison also crops out in a large area in the Black Hills, especially on the west side. Recharge areas for these aquifers would likely be in these mountains. The Colstrip well is artesian with a static pressure of about 200 pounds per square inch (psi). Percolation of the water through the sediments within the Powder River Basin would not be expected to generate such pressures. There are also thick sequences of shale which not only act as confining beds for the artesian system but would also prevent vertical recharge.

Any decision concerning the use of the deep aquifers as a source of industrial water would have to take into account:

1. amount of water available
2. number of wells that would be needed
3. well spacing
4. quality of the water

Flow rates were measured, well spacing was estimated, and water quality was determined from the Colstrip well. After an extended period of maximum



GENERALIZED CROSS SECTION FROM BIGHORN MOUNTAINS TO COLSTRIP SHOWING SOME MAJOR PALEOZOIC AQUIFERS AND GROUNDWATER MOVEMENT

Figure 11

free flow, the discharge was about 240 GPM (.54 cfs) and the water temperature was 207°F. Pumping could increase the yields from any one well.

Well spacing could be partly determined using the radlus of influence of the wells. The radius of influence is the distance that the well would influence other wells. Accurate estimates of this distance are difficult when using only one well. VanVoast, of the Montana Bureau of Minesand Geology, has estimated that this well would have a radius of influence of about 100,000 feet (20 miles), but it could be as little as 10,000 feet or as great as 1,000,000 feet. If wells were spaced so that their radii of influence overlapped, production from each well would be reduced resulting in the need for more wells or greater pumping.

To obtain 730 GPM (1.63 cfs) per well, spaced 2,000 feet apart, for 20 years, the pumps would require an estimated 2,500 to 3,000 horsepower per well (assuming 55 % efficiency for the pump). At this pumping rate, 12 wells would be needed (MPC, unpub.).

The quality of the water from the test well is poor. It seems that if water of this quality were used in the generating plant it would have to go through treament to remove or reduce some of the dissolved constituents. The following tabulation comprises typical water quality values for the test well with the values for the Yellowstone River at Miles City.

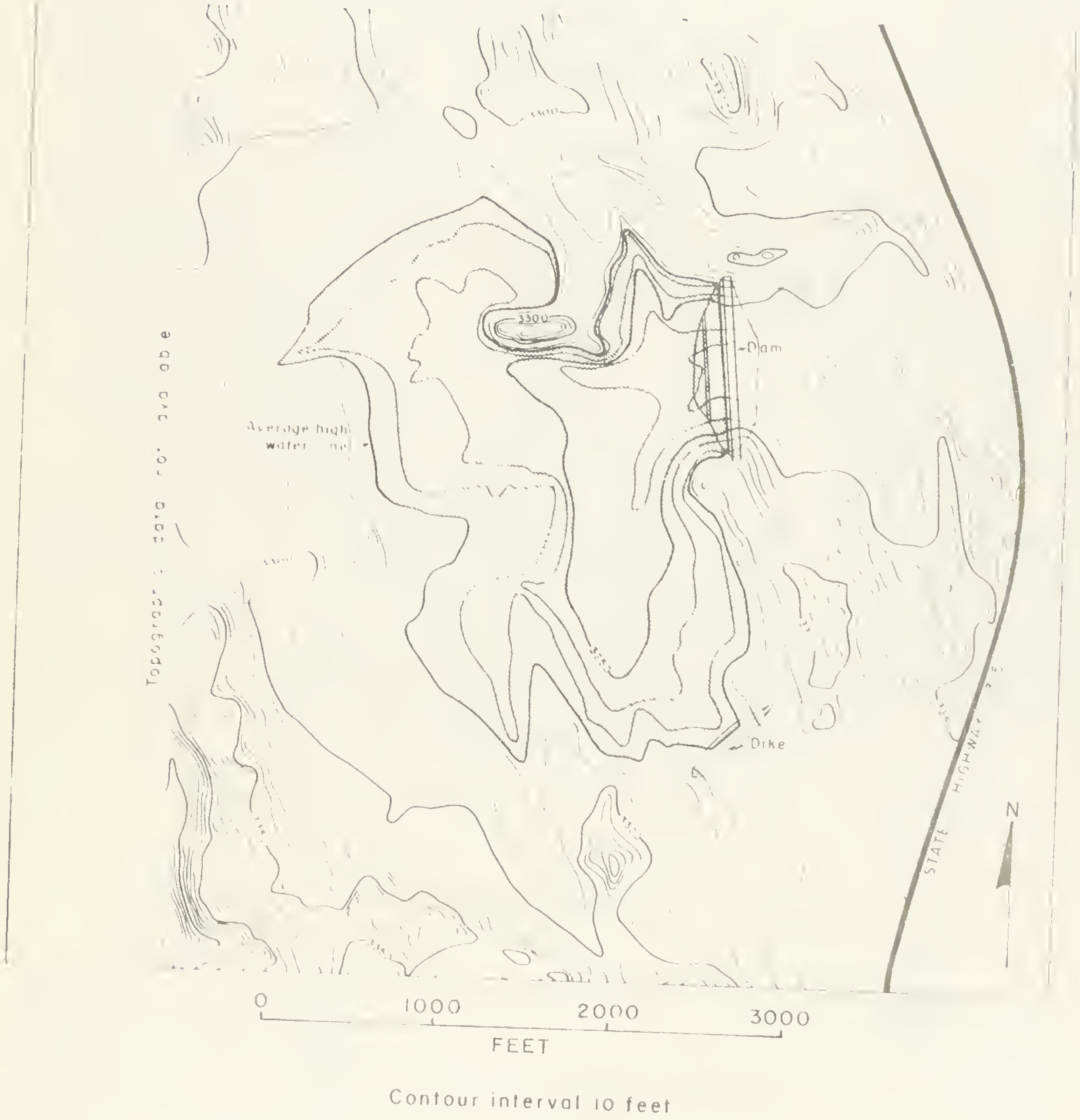
SUBSTANCE	RECOMMENDED LIMITS FOR DRINKING WATER	YELLOWSTONE RIVER AT MILES CITY	TEST WELL AT COLSTRIP
Sodium (ppm)	___	35	300
chloride (ppm)	250	4.1	200
sulfate (ppm)	250	118	750
total dissolved solids (ppm)	500	350	1500
silica (ppm)	___	___	60 (considered high)

It must be pointed out that little is known concerning the deep aquifers. The small amount of information gathered at the Colstrip test well and other wells within the Powder River Basin does not give an understanding of all the problems that might be involved in the exploitation of this water. For instance, we do not know what the recharge rates are. If the recharge rate is smaller than the pumping rate (for all purposes, including oil production), then the water will simply be mined, and the resource will have a finite life span. Other consequences of extensive pumping from the deep aquifers are similarly unknown

However, the deep groundwater in the Powder River Basin is a potential resource which may be more extensively developed in the future.

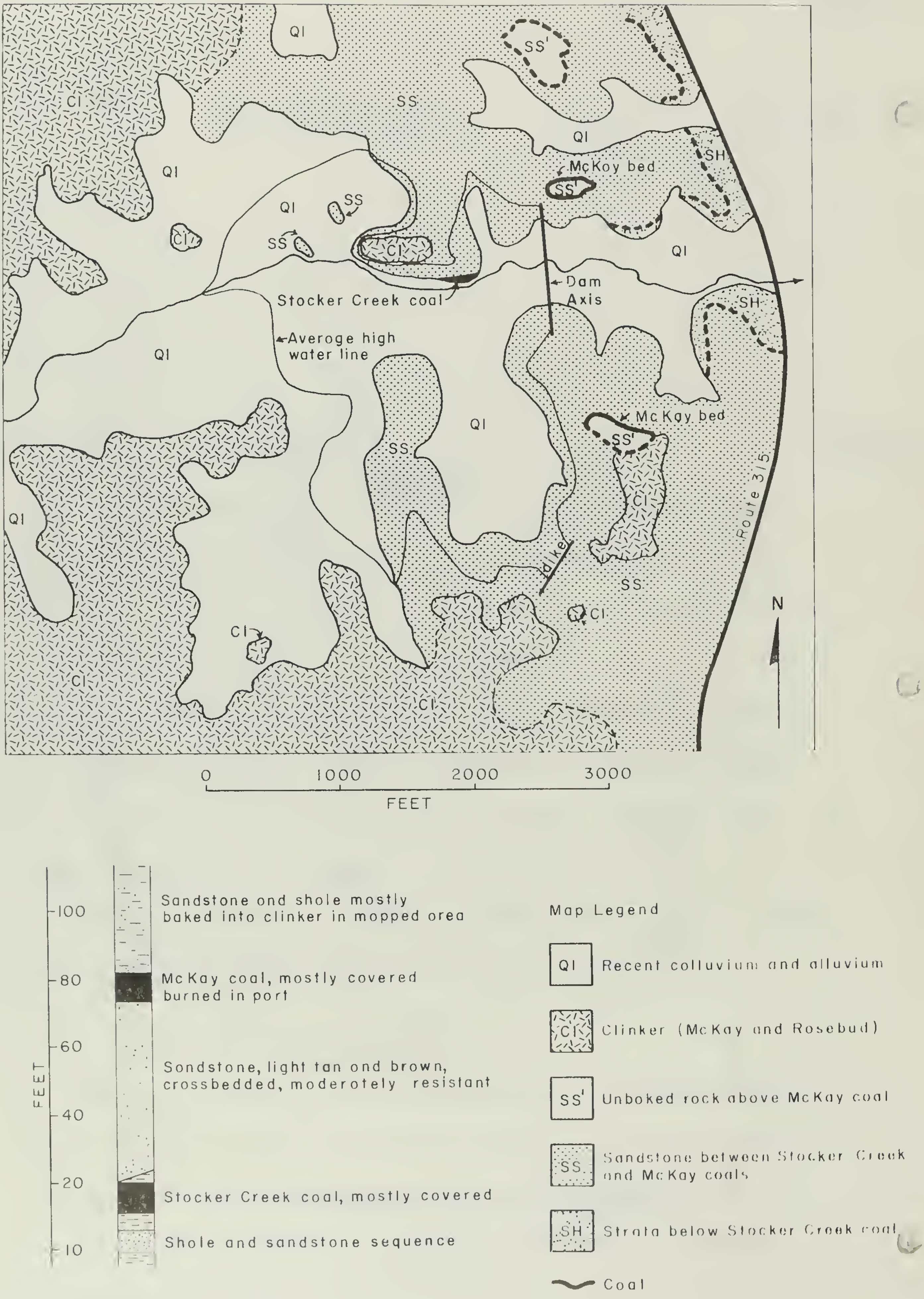
5.1.4.7 Geology of the Surge Pond Site

Figure 12 and Figure 13 are larger scale topographic and geologic maps of the site proposed for the surge pond. The entire area covered by this map is underlain by the Tongue River member of the Fort Union formation. Two coal beds, stratigraphically below the Rosebud bed, crop out in this area. These coals are the McKay and Stocker Creek beds.



TOPOGRAPHIC MAP OF SURGE POND SITE

Figure 12


Ql
SS'
SS
Cl
Ql
SH
McKay bed
SS'
Ql
SS
Ql
SS
Cl
Cl
Ql
Dam Axis
Stocker Creek coal
SH
Average high water line
Ql
Ql
McKay bed
SS'
SS
Route 315
Cl
Ql
Dike
SS
Cl
N
Cl
Cl
Cl
0
1000
2000
3000
FEET
100
80
60
40
20
10
FEET
Sandstone and shale mostly baked into clinker in mapped area
McKay coal, mostly covered burned in part
Sandstone, light tan and brown, crossbedded, moderately resistant
Stocker Creek coal, mostly covered
Shale and sandstone sequence
Map Legend
Ql Recent colluvium and alluvium
Cl Clinker (McKay and Rosebud)
SS' Unbaked rock above McKay coal
SS Sandstone between Stocker Creek and McKay coals
SH Strata below Stocker Creek coal
Coal

GEOLOGIC MAP AND STRATIGRAPHIC COLUMN OF SURGE POND SITE

Figure 13

The dominant rock types within the mapped area are sandstone and clinker. Clay, shale, and coal are present but strata of these rock types are thin and poorly exposed. A considerable amount of the area is covered by alluvial and colluvial material which completely obscures the bedrock.

The Stocker Creek bed was observed in only one location, that being about 600 feet west of the dam axis. From the drill hole data supplied by Montana Power Company, this coal bed is about eight feet thick and is underlain by thin beds of shale and sandstone. The exposed coal was somewhat oxidized in appearance and was considerably stained with sulfur.

Overlying the Stocker Creek bed at this locality was a white sandstone which appeared to be the base of the predominant sandstone in the vicinity. The very light color of the rock at this exposure could be the result of having recently been exposed by test digging done by the engineers. The naturally exposed and weathered sandstone slightly higher in this section is darker in color both on exposed and fresh surfaces. According to test hole data, the sandstones are the same unit.

This unit is a fine to medium-grained sandstone containing some silt and clay. On weathered surfaces the rock is a light brown color. On steep surfaces where decomposition of the rock is proceeding rapidly it is often much lighter, approaching white in places. In a few places this sandstone unit contains numerous concretions which weather out of the rock and litter the ground. These concretions appear to be cemented with limonite and have that same brown color.

The sandstone overlying the Stocker Creek coal crops out on the sides of the knobs at the ends of the dam, at the base of the hill just west of the dam, and on isolated outcrops within the area to be flooded. A low knoll is composed of this sandstone southwest of the dam. If the impoundment is built as proposed, the water will be contained all along its east and northeast sides by this sandstone. The McKay coal bed occurs at the top of this sandstone.

The McKay coal crops out near the top of the hill at the north end of the dam and on the hill south of the dam. The coal outcrop south of the dam leads to a clinker unit. An old underground mine entrance along the north edge of the mapped area indicates this coal might exist under that hill also. The clinker at lower elevation south of the dike appears to be that of the McKay burn, but the thick clinker beds in the south central and southwest corner of the mapped area probably include the Rosebud burn as well. The origin of the clinker in the northwest corner is, at least in part, McKay.

At the north end of the dam no good exposures were found above the McKay coal. However, the clinker of this zone found 1,000 feet west of the dam axis indicates a predominance of sandstone. This interval in its unbaked condition, is less resistant than the lower sandstone and occurs only as small patches above the more resistant sandstone which holds up the hills. Pieces of clinker, not _in situ_, occur above the unburned McKay bed. These isolated pieces are most likely remnants of the higher clinker of the Rosebud bed that has been mostly removed by erosion. The following photographs show some aspects of the surge pond site.

Exposure of Stocker Creek coal and overlying sandstone. Hill in background is clinker from the burning of the McKay coal.

View looking west from below the axis of the dam. Dam will cross valley on nearside of the cabin.

View looking southwest from north end of dam. Tree-covered slopes beyond the cabin will lie beyond the area to be flooded.

Erosional forms of the sandstone overlying Stocker Creek coal.

Tree covered hill at south end of the dam. The automobile on the right of of the picture will be on down-stream edge of the dam.

5.1.4.8 Groundwater Situation at Surge Pond Site

The ground water systems near Colstrip are strongly influenced by the numerous coal beds, sandstones, clinker beds, and clay units in the Tongue River member.

The Rosebud coal bed is of particular interest in the vicinity of Colstrip because of its relation to the mining and the fact that it is a significant regional aquifer. Although the Rosebud seam has been removed by erosion from the dam site, clinker formed by the burning of this coal comprises the hills to the west and south of the flooded area.

Underlying the Rosebud coal is an underclay which varies in thickness from a few feet to almost 60 feet. This clay is poorly permeable and serves to prevent water in the overlying coal from moving vertically. The McKay coal bed lies beneath this clay; although, at the pond site, there is a considerable amount of sandstone overlying the McKay coal (in the clinker west of the dam axis). The McKay seam is also an aquifer which is used where the Rosebud is missing.

At the surge pond site, the most important units are the sandstone underlying the McKay coal, the Stocker Creek coal, and the strata under the Stocker Creek bed. The impounded water will be contained mostly by the sandstone. The amount of loss of water from the pond to the ground will be partly determined by the permeability of the sandstone. VanVoast, of the Montana Bureau of Mines and Geology, has done extensive work in the area which indicates that the sandstone is not highly permeable. This coal is highly fractured and at the test pit, where the top of the coal in now exposed, water ran from the coal and filled the pit. An underclay about six feet thick exists under this coal which probably restricts vertical movement of the water in the coal and sandstone above.

A gentle dip of the beds in this region causes groundwater to flow to the south and southeast toward Colstrip (Westinghouse Report, 1973). The location where the Stocker Creek bed passes into the alluvium has not been mapped, but is probably near the north edge of the town. From available data it appears that the coal bed is well below the East Fork of Armell's Creek, due south of the dam. Perhaps some of the water in this aquifer system gets into the creek, but some, most likely, misses it. It must be emphasized that the details concerning this aquifer system are not known.

5.1.5 Soils

Soils maps available for the study area are only of the most general types. More extensive mapping has been done along Armell's Creek valley and up the east fork to Colstrip. This is the valley where the pipeline and transmission line are proposed to be built.

The dominant soils of Armell's Creek valley are McRae, Fort Collins, Nunn, Haverson and Lohmiller series. The most recent description of these soils appears in the Soil Conservation Service's Yellowstone County Soil Survey publication.

The McRae soils are deep, well drained, nearly level to strongly sloping calcareous soils on terraces, fans and valley sides. The native vegetation is needle-and-thread, blue grama, western wheatgrass, big sage, and silver sage. In a typical profile the surface layer and subsoil are grayish-brown loam about 9 inches thick. The lower part of the subsoil is calcareous. The substratus is a pale yellow loam or fine sandy loam and is strongly calcareous. Its permeability is moderate, and the available water holding capacity is 8 to 10 inches. The organic matter content and fertility are moderate. These soils can be used for dry and irrigated farming and for range.

The Fort Collins soil is similar to the McRae series, except the plow layer is a medium-textured loam and the subsoil is also a clay loam texture. The heavier textures will allow adequate water movement through the profile. These soils are used for dry and irrigated farming and for range.

The Nunn series have more clay throughout the profile than the McRae or Fort Collins soils. The "B" horizon is light clay with prismatic structure, which causes a saturated condition for a longer period of time after a rain although this is not an extreme hazard. The soil generally has good drainage in the upper profile. However, in some irrigated areas the water table is within 5 feet of the surface; a few seeped areas show in irrigated areas. Test holes should be augered to observe the water table before digging a trench.

The Haverson series are well drained, nearly level to moderately sloping calcareous soils that are more than 60 inches deep. The typical profile is a texture of loam to silt loam with good drainage of gravel and loose sand appearing at 58" to 68". The soils may be within the floodplain of the stream. However, some of the highest yields of dry and irrigated crops come from the Haverson soils.

The Lohmiller soils are generally in association with the Haverson series with the main difference being that the Lohmiller series is formed in a clayey, stream-deposited alluvium. In a typical profile, the plow layer is grayish brown, silty clay, 9 inches thick. The substratum is stratified calcareous clay, clay loam, loam and sandy loam. The coarser textured layers occur in the deeper substrata. Permeability of Lohmiller soil is moderately slow, and the water holding capacity is 8 to 10 inches with primary usage being dry and irrigated farming. The drainage under irrigated usage would be good because of the light textured substrata. When constructing a trench through these soils, care should be taken in compacting back fill because the sandy substrata placed in the trench first may cause excessive settling and a depressed surface in the trench area.

The Heldt series occupies several areas within the valley. The series consists of deep, well-drained, silty clay loam soils that formed in clay alluvium deposited valleys. The native vegetation is mainly western wheatgrass, needlegrass and sagebrush. In a typical profile the surface layer is grayish-brown silty clay loam 3 inches thick. The subsoil is grayish-brown silty clay loam and silty clay several feet thick. There permeability is slow, and available water capacity is 8 to 10 inches. The silty clays and silty clay loams will slow vertical movement of water, and spring rains especially would be a problem when constructing across areas of Heldt soils.

The Keiser series are similar in texture to the Heldt soils. In a typical profile the surface layer is grayish-brown silt loam 2 inches thick. The subsoil is brownish silty clay loam and silty clay about 8 inches thick while the calcareous substratum is light-gray silty clay loam to silt loam. The permeability is slow, and available water holding capacity is 10 to 12 inches. These soils are used for dry and irrigated farming and for range. Construction through these soils when in a saturated condition after rain should be avoided until the soil has dried out.

5.2 Cultural Environment

5.2.1 Introduction

Cultural environments are as diverse as the natural environments in which they exist; the analysis process necessitates separating this complex into workable units. For this reason, the cultural environmental analysis and impact references are summarized by the following categories:

Population
Social Fabirc
Residential
Public & Quasi-Public
Commerce
Transportation
Ranching
Agriculture
Recreation
Historical-Archaeological
Land Ownership
Land Use

5.2.2 Cultural Reference Maps

As visual aids, five reference maps relating to the cultural environment of the study area are included herein. They are:

1. Existing Land Use I - Linear Patterns
2. Existing Land Use II - Site Patterns
3. Potential Land Use
4. Surface Land Ownership
5. Historical-Cultural Significance

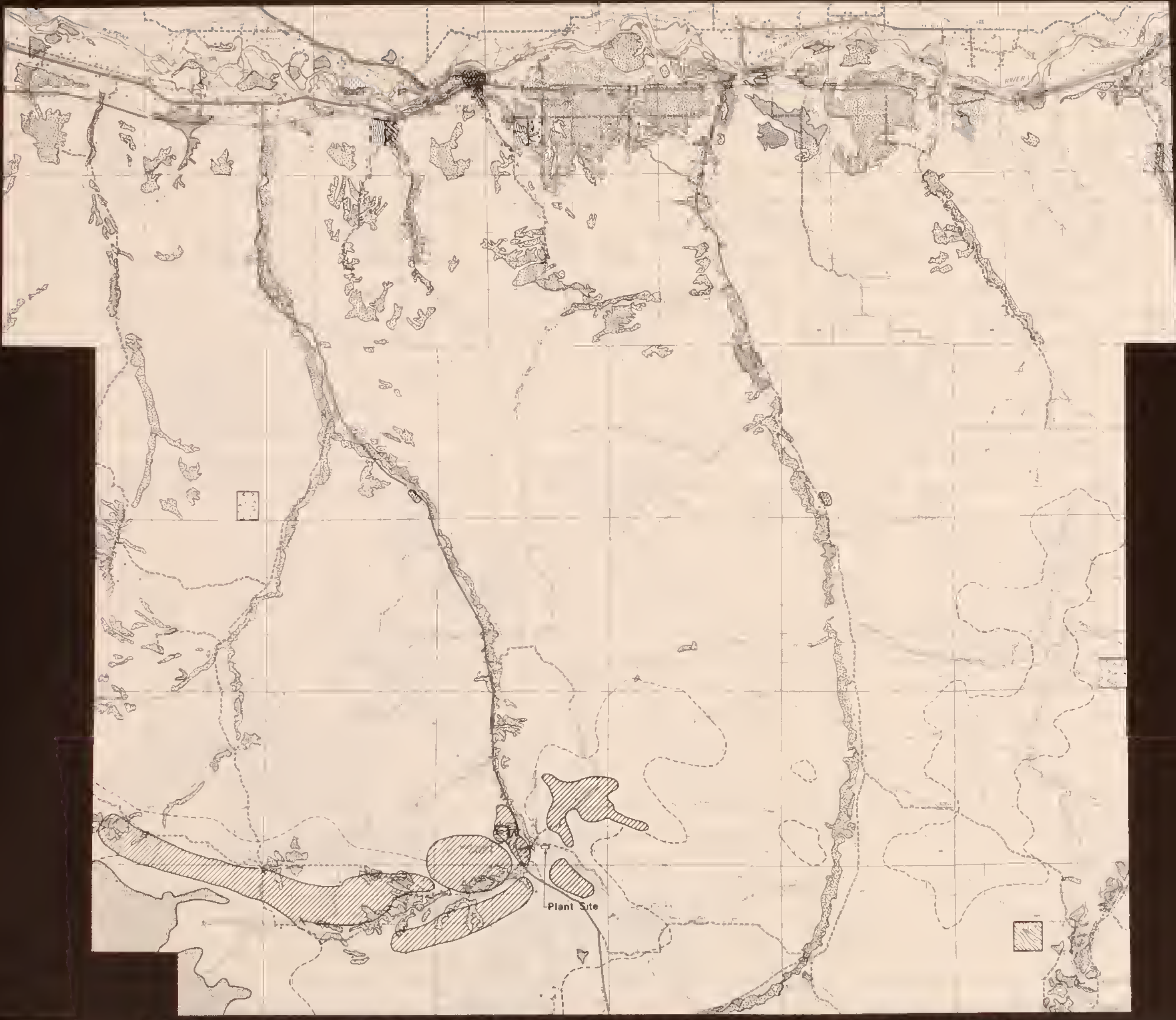
Linear patterns refer to existing facilities that create continual, horizontal, and highly directional patterns on the landscape. Significantly, these linear patterns tend to delineate and fragment land uses and are especially important criteria in determining future land-use patterns. Utilities and transportation systems fall into this category.

Site patterns on the other hand, refer to non-linear land-uses that generally involve large tracts of land or land masses. On the reference map, they appear as islands or "bulks" of land and may exist separately, in series, or as contiguous land-use entities.

The remaining reference maps are self-explanatory.

5.2.3 Population

In 1970 the best estimate of the study area's population was 2,580. Of this figure, major concentrations were as follows: Forsyth, 1,873; Rosebud, 225; Colstrip, 200; and Hathaway, 40 (from 1970 Census of Estimates). County-wide average population density is estimated at 1 to 2 persons per square mile



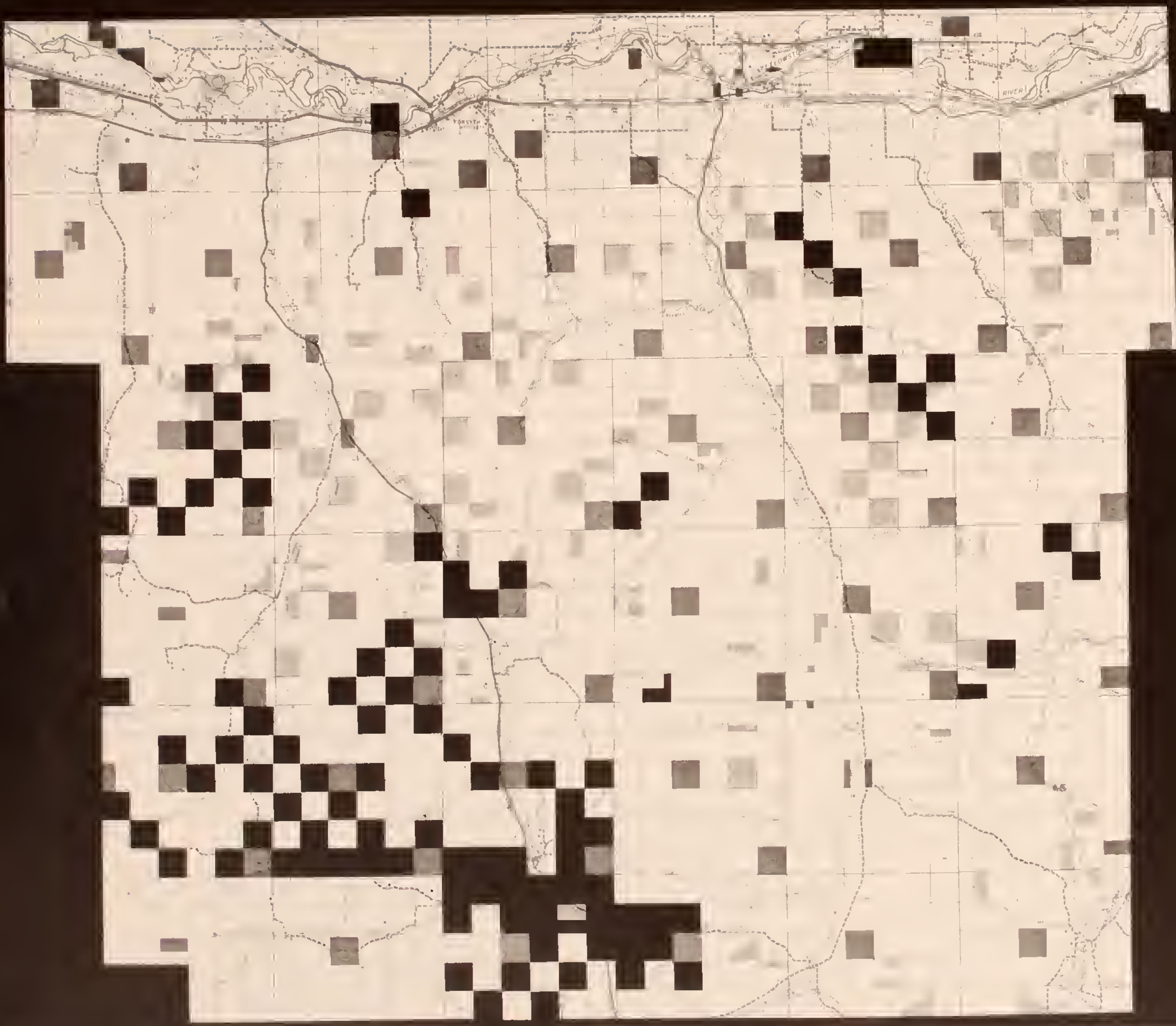
COLSTRIP UNITS 1 & 2 ASSOC. FACILITIES - WATER SUPPLY & 115 KV LINE

POTENTIAL LAND USE

- ▨ CONTRACTED COAL EXTRACTION
- ▒ SNOWMOBILING
- ▤ SANITARY LANDFILL
- ▧ SUBDIVISION
- ☐ LIGHT LUMBERING
- ☐ MUNICIPAL VEHICLE STORAGE
- ▧ STATE LAND POTENTIAL RECREATION
- ◌ LEASABLE COAL EXTRACTION
- ● RESIDENTIAL OR COMMERCIAL
- ⊖ RECREATION·WATER RELATED
- ▥ IRRIGABLE LAND CLASS 1
- ▒ IRRIGABLE LAND CLASS 2
- ▒ IRRIGABLE LAND CLASS 3
- ☐ NON IRRIGABLE LAND

SOURCE
STATE MINES 1973
BLM 1973
STATE LANDS 1973
WATER RESOURCES 1971

ENERGY PLANNING DIV., DNR & C, HELENA, MT. • SCALE: 1/2" = 1 MI.



COLSTRIP UNITS 1 & 2 ASSOC. FACILITIES - WATER SUPPLY & 115 KV LINE

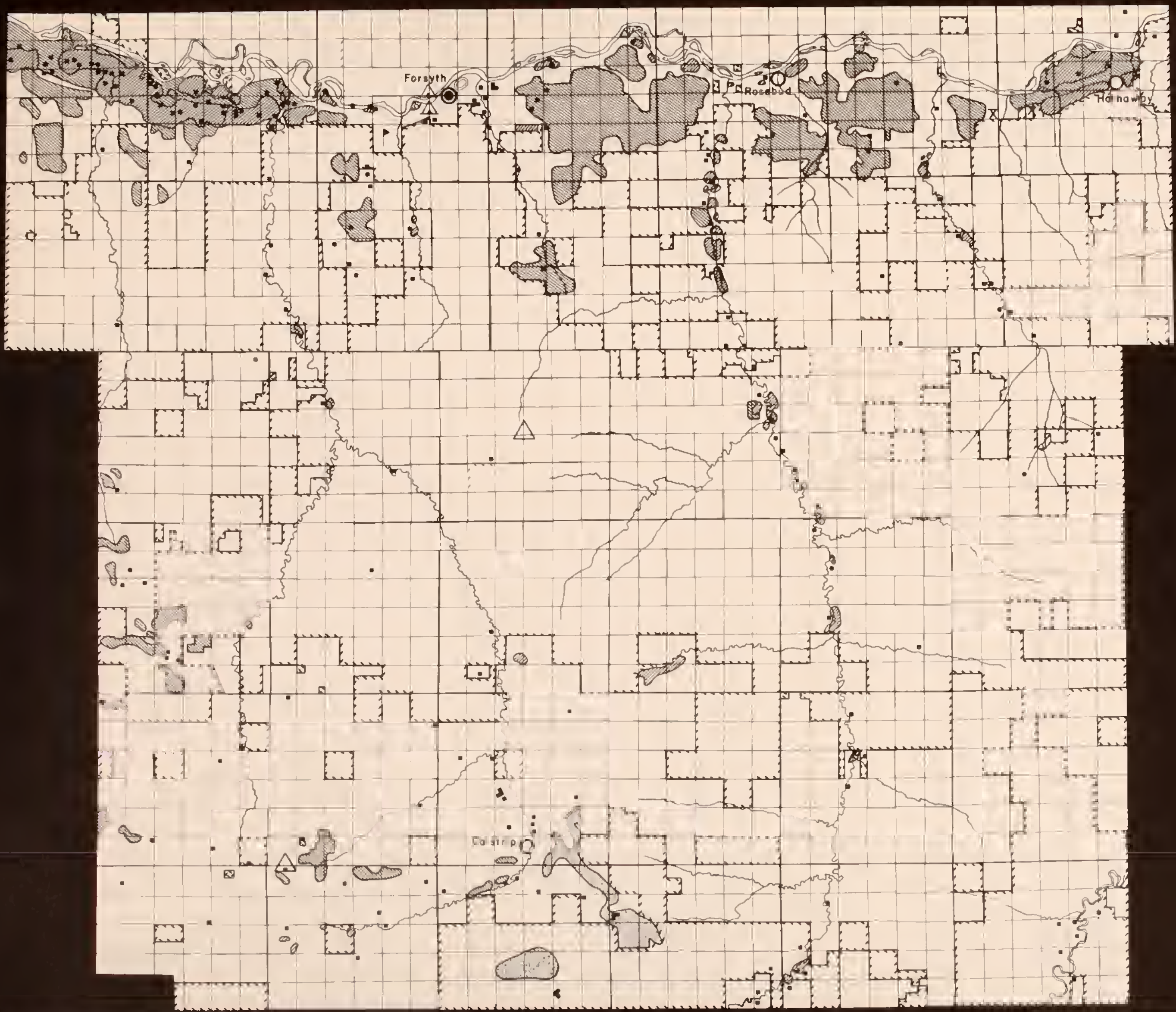
SURFACE LAND OWNERSHIP

LEGEND

▨ BLM LANDS
▨ STATE LANDS
☐ PRIVATE
■ CORPORATE

SOURCE
BLM & STATE LANDS 1972

ENERGY PLANNING DIV., DNR & C, HELENA, MT. SCALE 1/2" = 1 MI.



COLSTRIP UNITS 1&2 ASSOC. FACILITIES • WATER SUPPLY & 115 KV LINE

EXISTING LAND USE II
(SITE PATTERNS)

- ▨ COAL EXTRACTION
- ▨ AGRICULTURE · IRRIGATED
- ▨ AGRICULTURE NON-IRRIGATED
- ◉ INCORPORATED CITY·VILLAGE
- ○ URBAN-SUBURBAN
- LIVESTOCK FORAGE
- △ UNIQUE LANDFORM·VIEW
- ROCK HOUNDING
- △ REC. AREA W/ACCESS
- X REST AREA
- FORSYTH COUNTRY CLUB
- FAIRGROUNDS
- SMALL BUSINESS ESTAB
- • DWELLING

SOURCE
BLM 1972
STATE LANDS
FISH & GAME 197
STATE MINING 197
MT COUNTY HIGHWAY MAP

ENERGY PLANNING DIV., DNR&C, HELENA, MT. • SCALE 1/2"=1 MI.

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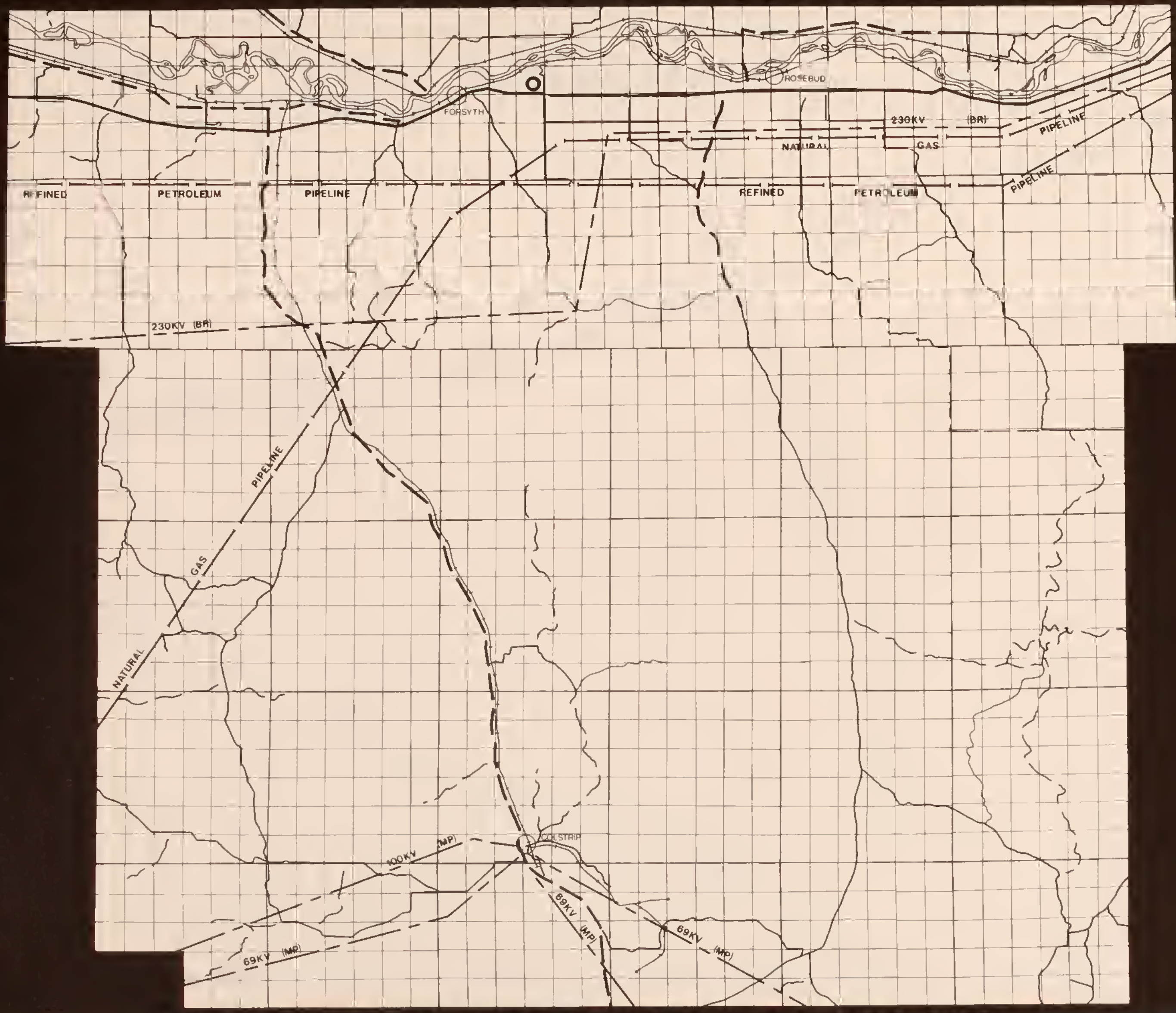


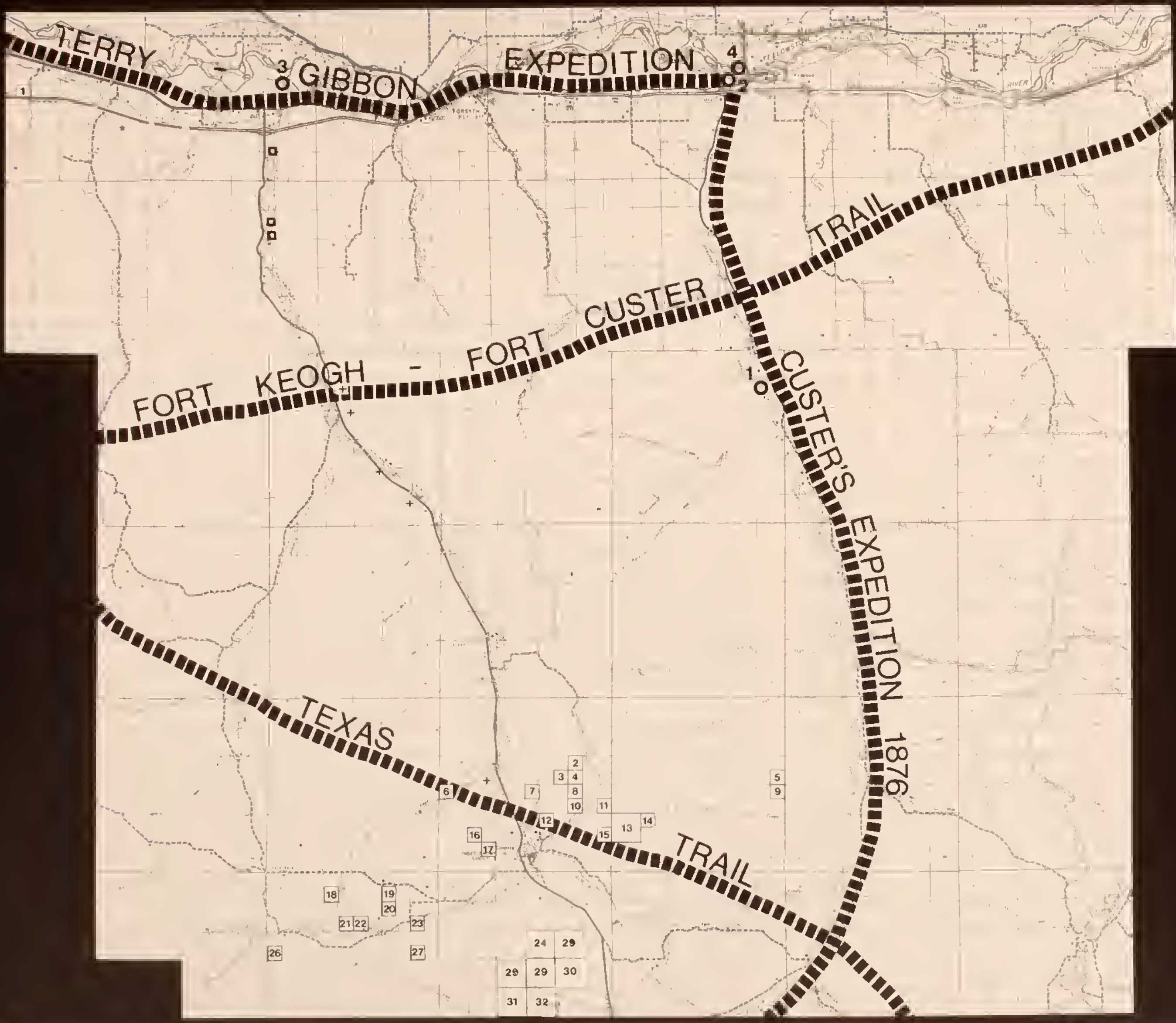
COLSTRIP UNITS 1&2 ASSOC. FACILITIES - WATER SUPPLY & 115KV LINE

EXISTING LAND USE I
(LINEAR PATTERNS)

- POWER LINES
- NATURAL GAS PIPELINE
- PETROLEUM PIPELINE
- RAILROAD
- ○ AIRFIELD
- FOUR LANE HIGHWAY
- TWO LANE HIGHWAY
- GRAVEL ROAD
- UNIMPROVED ROAD
- PRIMITIVE ROAD

SOURCE
MONT. COUNTY HIGHWAY MAP
MONTANA POWER COMPANY
MONTANA OIL AND GAS
CONSERVATION

ENERGY PLANNING DIV., DNR&C, HELENA, MT. - SCALE 1/2"=1 MI.



COLSTRIP UNITS 1 & 2 ASSOC. FACILITIES - WATER SUPPLY & 115 KV LINE

HISTORICAL - CULTURAL SIGNIFICANCE

LEGEND

○ FORTS, CAMPSITES

3 ARCHAEOLOGICAL FINDINGS

▮▮ EXPEDITIONS, TRAILS

+ SCATTERED EVIDENCE

▫ HOMESTEAD

SOURCE	
BLM	1972
UofM	1973

ENERGY PLANNING DIV., DNR&C, HELENA, MT. • SCALE 1/2"=1 MI.

(HES, Sept., 1973). Rosebud County has a net out-migration from 1960-1970 (as percent of 1960 population) of 14.5%. Considering internal birth and death rates, Rosebud County still showed an absolute decrease of 2.51% (Mont. Agri. Exp. Station, 1973). If the latter trend were to continue, a 1980 projected population for the study area would reflect the 2.51% decrease of 65 persons. However, the combination of increased coal mining activities and proposed electrical power generating plants in the study area will alter these figures considerably.

The most drastic population changes are taking place in Colstrip. The population growth (combined permanent and temporary) is estimated to peak at 1,866 by 1975 and settle around 1,781 by 1978 (K.R. White Co., Dec., 1972).

Accordingly, Colstrip's 1970 population of 200 will increase by approximately 850% by 1975 and 800% by 1978. The total study area's population then, can be estimated at 4,096 which represents an increase of approximately 160% by 1978 (over 1970 figures).

5.2.4 Social Fabric

Although livelihood activities involve some externalization (beef trade, for example), the social fabric of the study area is definitely local in nature. Reared in a relatively land-oriented atmosphere (the study area is dominated by ranches and farms), agrarian and rural by choice, and self-reliant by nature, residents gear social activities accordingly. Although residents share common goals, needs, and concerns, social integration takes place at the individual rather than at the group level. Theirs is an accepted way of life

that places less emphasis on what is often called "cultural amenities" and more on mutual respect for individual life styles.

As a result of current development proposals for the study area, future social patterns will most assuredly undergo modification, especially in the immediate Colstrip vicinity. The degree of these changes remains speculative. However, it is not unreasonable to assume that with an accelerated population influx and a shift in economic base, there will be adjustment difficulties.

5.2.5 Residential

Four areas (Map: Existing Land Use II - Site Patterns) have been classified as urban-suburban in nature, i.e., areas of high density residential makeup. They are: (from east to west) Hathaway, Rosebud, Forsyth (the largest and also the county seat), and Colstrip. Other than these four, the entire study area is predominantly rural with widely scattered dwellings, farms and ranch units. With increased coal mining activities, it is reasonable to predict residential increases in all of these communities. Forsyth and Colstrip appear to have the greatest residential growth potential. Because of its existing amenities, Forsyth will probably experience immediate (short range) expansion, though Colstrip will receive the greatest pressure for long range residential expansion. One study (K.R. White, Co., 1972) projects an eighteen-year household increase of 130% for the Colstrip area. Other more rural areas will probably undergo slight residential changes, depending on the intensity of coal mining and power plant activities.

5.2.6 Public and Quasi-Public

Public and quasi-public facilities provide area residents with certain basic community needs. These include fire and police protection, banking and loaning institutions, health care, schools, churches, sanitary water supplies, sewage systems, and the like. They may be publicly financed and managed or privately funded and managed but exist for the good of the public at large. Forsyth, being the most populated community and the county seat, naturally has more of these amenities. Smaller communities have limited services and residents must rely on Forsyth or travel to larger municipalities such as Miles City. In smaller towns and rural areas some services such as sewage disposal must be provided by the individual.

Present services, although limited, appear adequate (except perhaps hospital needs). As Colstrip continues to develop (with increases in population) additional public and quasi-public facilities will be required.

5.2.7 Commerce

Total land-use for commercial activities within the study area is negligible and confined to urban-suburban areas. These are highly local in nature, i.e., gas stations, hotels, motels, taverns, grocery stores, and the like. There are some timber and wood product activities, but, again, these are local and their land-use is relatively insignificant. Sand and gravel is extracted along the Yellowstone River with 90% of the products being used for highway construction.

The major industry evident in the study area is the extraction of coal. Current land used for coal mining activities is concentrated in two areas--to the south and southeast of Colstrip (Map: Existing Land Use II - Site Patterns). At present, two companies are actively engaged in coal extraction: Peabody Coal Co. (Kennecott Copper Corp.) and Western Energy Co. (Montana Power Co.). This industry is discussed further in section 5.1.4.4.

Commercial enterprise will undoubtedly increase (particularly local businesses) as an increasing population places greater demands on this sector. The greatest pressure for increasing commercial services will be experienced in the immediate Colstrip vicinity.

5.2.8 Transporation

At the present, existing transportation systems appear adequate for meeting area needs (Map: Existing Land Use I - Linear Patterns).

Interstate Highway #94 traverses the northern portion of the study area. It is classified as a limited access road, is well maintained, and provided excellent east-west access to the area. Old State Highway 10 also provides east-west movement within the area. Highway 12 provides access (via Interstate Highway 94) to the area from the north. North-south travel through the entire study area is provided by State Highway 315 which is 2-laned and paved. Numerous lateral roads of varying quality interlace the entire study area; apparently, there are no accessibility problems.

The Burlington-Northern Railroad serves Rosebud county, paralleling the Yellowstone River in an east-west direction. The railroad also traverses the study area with a north-south trunk line providing services to Colstrip.

These services consist primarily of freight shipments, beet hauling, and coal unit-train deliveries. Amtrack (a government corporation using existing railroad facilities) also provides passenger service along the east-west route.

The Greyhound Company provides busing services three times daily, east or west.

Motor freight services are provided by Burlington-Northern and Garrett Freight lines.

Presently, there are no commercial airlines serving the area, although Forsyth and Hysham have airports. In addition, several ranchers have private planes and landing facilities. Also, there is an airstrip located at Colstrip.

It is reasonable to assume that as Colstrip develops, coal mining activities increase, and two electric generating plants (currently being constructed) become operable, increased demands will be placed on existing modes of transportation. Undoubtedly, some expansion will take place, but initially, this will be local in nature, involving increased numbers of service roads and gradual expansion of the existing airstrip into a more sophisticated air terminal.

5.2.9 Ranching

By far, the most important activity in the study area is ranching; the raising of livestock accounts for approximately 88% of its land use (Maps: Existing Land Use II - Site Patterns and Potential Land Use). Raising cattle, sheep, hogs and horses is the primary source of income. Hence, it forms the area's economic base. There is a definite trend toward increasing feed lots as well as depending on locally grown feeds. However, this trend is limited by the number of acres available for feed production and the management skills of the rancher. Increased interest in coal extraction and power generating facilities in the area will undoubtedly cause a shift toward a more mixed economic base. This could result in a decrease in total acreage available for forage and feed crops.

5.2.10 Agriculture

On a percentage basis, land used for agricultural purposes (cropland) is between 5% and 6%. The combined effects of erratic growing seasons, topography, and lack of cultivable soils pose severe limitations on agricultural activity. Both irrigated and non-irrigated crop-raising techniques are used, the latter occuring in a scattered pattern throughout the study area, and the former highly concentrated along the Yellowstone River with some occurence along its tributaries (Map: Existing Land Use II - Site Patterns). "As of 1948, the Yellowstone Irrigation District was the only irrigation project in the study area. Remaining irrigation consists of sprinkler, pump, or water-spreader systems" (USDA, 1972). The main crops raised are hay, wheat (hard winter), sugarbeets (cash crop) and corn. Other crops include oats, barley, and beans. Few cash crops are grown, as most of the land is used for the production of hay for livestock forage. The USDA has made the following comment:

> Crop variety trials are continually being conducted by research people seeking more information on new, improved varieties that will ultimately mean more net return to farmers. The number

of farm operators has not changed significantly in Rosebud and Treasure Counties over the past ten years. A number of units have undergone reorganizations. In general, with high interest rates, high taxes, new investment aspects on machinery and inflated land values, most problems on irrigated farms are economic in nature and not agronomic. Thus the concept of corporate farms is a topic more often discussed today, but farmers would rather continue to make their own decisions (USDA, 1972).

5.2.11 Recreation

Hunting and fishing are the major recreational activities in the study area (see Wildlife, section 5.1.3, for further details). In general, fixed or defined recreational sites are lacking (Map: Existing Land Use II - Site Patterns). The Montana Department of Fish and Game maintains a recreational area on the Yellowstone River near Forsyth with boating and fishing access and picnicing facilities. Rock collecting is a popular activity all along the Yellowstone River. Most rock hounds are hobbyists, but some agates are sold to lapidarians as semi-precious stones for use in jewelry items. The Montana Department of Highways has furnished waysides for travelers on Interstate Highway 94 near Hathaway. The city of Forsyth has a boat club and a fairground. Forsyth also leases property from the Department of State Lands for a public country club which has a club house and golfing, archery, and trap shooting. At present, recreational facilities at Colstrip are limited. However, as this community continues its rapid rate of population influx, the need for leisure time activities will place a greater demand on the expanding recreational sector.

The Plan for Colstrip (K.R. White Co., 1972) points to this fact. The

Plan calls for developing a play field (open area for field games), a park (landscaped area for passive activities), tot-lots (areas with play equipment for children), a teen and community center (with craft activities for various age groups), and a series of bicycle paths. Implementation of this plan will apparently depend on local support and enthusiasm.

Development of a fishery and of snowmobile trails appears to have real potential. There is also good potential for increased recreational activity along the Yellowstone River. "There is a medium potential for picnicing and field sport areas. Camping grounds, vacation cabins, cottages, and home sites fall on the low end of high potential" (USDA, 1972).

5.2.12 Historical-Archaeological

Historical sites within the study area consist of expedition routes (followed by explorers during the 1800's), trails, forts, and campsites that came to have historical value (Map: Historical-Cultural Significance). Although the latter sites became more permanent and strategically military-oriented, they originally served as natural meeting places or "open markets" for the exchange of furs and implements. Hence, another facet of early western history can be extrapolated from their remains. Following is a list of historical sites that exist within the study area:

Forts - Campsites

- Fort Alexander, 1842
- Fort Sarpy I, 1850
- Fort Van Buren, 1835
- Custer Campsite

COPY PROVIDED BY THE
MONTANA HISTORICAL SOCIETY

Expeditions - Trails

Terry-Gibbon Expedition

Fort Keogh-Fort Custer Trail

Custer's Expedition, 1876

Texas Trail

The following fort descriptions were provided by the Department of Fish and Game:

> Fort Alexander: Built in 1842 by Charles Larpenteur for the American Fur Company. One of the company's series of posts in the Crow country and valuable in maintaining contact with these friendly Indians. (Note: This site is currently being researched for any possible archaeological significance.)
>
> Fort Sarpy I: Built in 1850 by Alexander Culbertson for the American Fur Company. One of their series of posts in the Crow country. Culbertson was long active in the Upper Missouri and Yellowstone trade. He and his wife, Medicine Snake Woman, were particularly valuable as interpreters and negotiators in the dealings of the government with these upper river Indians.
>
> Fort Van Buren: This post was built in 1835 by Samuel Tullock for the American Fur Company, replacing earlier Fort Cass. One of a series of posts important in keeping up the friendly relations of the company and government with the Crow Indians. It proved valuable in later years.

Archaeological sites are numerous in the study area; the following list (U. of M., Dept. of Anthropology, Archaeological Library) outlines sites, describes types, and is keyed to the reference map; Historical Cultural Significance.

Map Key	Site Name	Type of Site
1.	Mission Creek Site	Quarry Site
2.	Eagle Rock Site	Lookout Station
3.	Fuzzy Bird Site	Occupation
4.	Horse Canyon Site	Occupation
5.	July 4th Site	Occupation
	2 Deer Springs Site	"
6.	Arrowhead Site	Occupation
7.	Henlay Site	Occupation
8.	Garage Site	Occupation
	Peter's No. 12 Site	"
	Forces Site	"
9.	Drifter Site	Occupation
10.	Jay Site	Occupation
11.	1/2 Site	Occupation
12.	Cows Chasing Jackson	Occupation
13.	Daughteny Site	Homestead
14.	Cow Creek Site	Occupation
15.	Little Deer	Occupation
16.	Ellison Petroglyph Site	Rock Art
	Ellison Rock Site	Habitation
	Old Homestead Site	"
	Farley Ridge Site	Approach Road
17.	Western Energy Shelter	Shelter

	The Cattail Site	"
18.	Cooley Site	Occupation
	Three Ring Site	Occupation & Tipi Ring
	Cooley Homestead Site	Homestead
19.	Lynn's Square Site	Quarry Site
20.	Farley Lookout Site	Occupation
21.	Pottery Site	Occupation & Pottery
22.	Caskay Site	Homestead
23.	Doc Taylor Place	Homestead
	Swift Wind Canyon Site	Quarry Site
25.	Lookout Point Site	Lookout Station
	Pyramid Mountain Site	"
	On-The-Way-Home Site	Open Habitation
	Big Cut Bank Fish Site	Rock Art
	Pyramid Mountain Petroglyph Site	"
	Lookout Point Petroglyph Site	"
	Trailor Court Cave Site	"
	Engineer Shelter	"
26.	Swrik Site	Homestead
27.	Jill Site	Occupation & Pottery
28.	Hot Dog Site	Lookout Station
29.	BLM Bison Trap	Bison Kills
30.	"	"

31.	Wind Devil Site	Lookout Station
32.	Tuma's Rock Site	Rock Art
	Horse Shelter	Rock Shelter
	Colt 45 Shelter	"

Following is a list of archaeological sites lacking legal decription (also from the Archaeological Library).

Site Name	Type of Site
3 Lobe Site	Occupation
Departure Site	Occupation
Morning Dove Snag Site	Occupation
Rocky Top Site	Occupation
McCrae Kill Site	Kill Site
Cavalry Site	Camp/Cavalry
Little Porcupine Site	Habitation and Rock Art
Tabletop Site	Rock Shelter
Dusty Shelter	Rock Shelter

Most of these finds are the result of Dr. Dale Fredlund's (Research Archaeologist with the Mineral Research Center, Butte, Montana) work in the area. Dr. Fredlund has advanced the theory that potential archaeological sites are more likely to exist where sandstone outcrops and ponderosa pine occur together. There is good evidence that prehistoric men and animals both used these sandstone-pine associations as natural vantage points in their search for food and shelter.

Another critical factor is the occurence of these associations along or near sources of water such as Armell's and Rosebud Creeks. Since these tributaries were undoubtedly used as natural highways (serving both predator and prey), sandstone-pine associations along or near these creeks exist as potential archaeological sites.

> The Montana Historic Preservation Plan with its comprehensive survey of historic sites is a result of the National Historic Preservation Act of 1966. The survey and plan will become not only the State guide for preservation and part of the files of the National Park Service, but will also be published for public information. Not only will the philosophy and goals of Montana for historic preservation be available to the public, but this survey of historic sites will enable a citizen to grasp the fullness of Montana's history and select aspects of special interest. Increased attention will also be given to preservation and restoration projects throughout the state. A system of matching grants-in-aid from the federal government will help provide financial assistance for these projects. It is hoped that great consideration can be given to assuring proper preservation and restoration through professional guidance and assistance (Fish & Game, 1973).

As the official Clearing House Agency for maintaining the Montana Historic Preservation Plan, the Montana Department of Fish and Game is currently updating and mapping known historical sites. This report will be available the early part of 1974.

5.2.13 Land Ownership

Along the proposed alternative pipeline corridors existing land ownership breaks the land into quilt-like patterns (Map: Surface Land Ownership). Available sources indicate that these properties are owned or administerd by one of the following: Bureau of Land Management, Montana Department of

State Lands, corporations or private individuals. Of the total study area (approximately 860,000 acres), less than 5% is administered by BLM and State Lands each, and approximatley 8% is owned by the Burlington Northern. The remainder is privately owned.

5.2.14 Land Use

As a result of the study area's physical setting and cultural environment, certain land-use patterns (Maps: Existing Land Use I - Linear Patterns and Land Use II - Site Patterns) have been established. These patterns [illegible] from individual decisions or agreements rather than from adherence to a formal comprehensive land-use plan. With increased corporate interest in extracting fossil fuels and mine mouth power plant operations, the probability of shifting land use patterns is high. In addition, a county planning board (to be located at Forsyth) is presently being formed.

6 Impacts

6.1 Natural Environment

6.1.1 Climate

The proposed powerline and pipeline alternative routes will have no effect on the macro or regional climate, and the only effects on the micro-climate will be insignificant.

6.1.2 Vegetation

The construction of the water intake structure, water pipeline, 115 KV transmission line, and the surge pond will alter the natural vegetation and agricultural crops to some degree. The effects may be temporary or permanant and are caused by removing natural vegetation and removing agricultural land from production. The intake structure and the surge pond are examples of actions that would permanently alter land use. Construction activities for the pipeline and transmission line will remove natural vegetation and crops and are considered temporary alterations.

An area bared of vegetation, especially if the topsoil is not replaced, will be subject to accelerated wind and water erosion and probably will be invaded by undesirable species (such as Canadian thistle). Revegetation by native species would alleviate these problems. On the other hand, introduction of exotic species could threaten adjacent native vegetation if the exotics have a competetive advantage. Impacts on vegetation will be subdivided in the following discussion into effects on natural and on agricultural crops. It should be kept in mind that to say an impact is unkown does not mean that there is no impact. Known impacts are only those that have been documented or that are intuitively obvious. More studies are urgently needed to determine the effects of powerlines and associated facilities on vegetation.

6.1.2.1 Intake Structure

Natural Vegetation

Alternative sites A and B for the water intake structure are on agricultural cropland and, therefore, will not disrupt natural vegetation. Alternative site C would remove small amounts of willow and juniper along the river.

Cropland

For alternative sites A and B, the water intake structure will remove approximately 17,500 square feet (0.4 acre) from crop production.

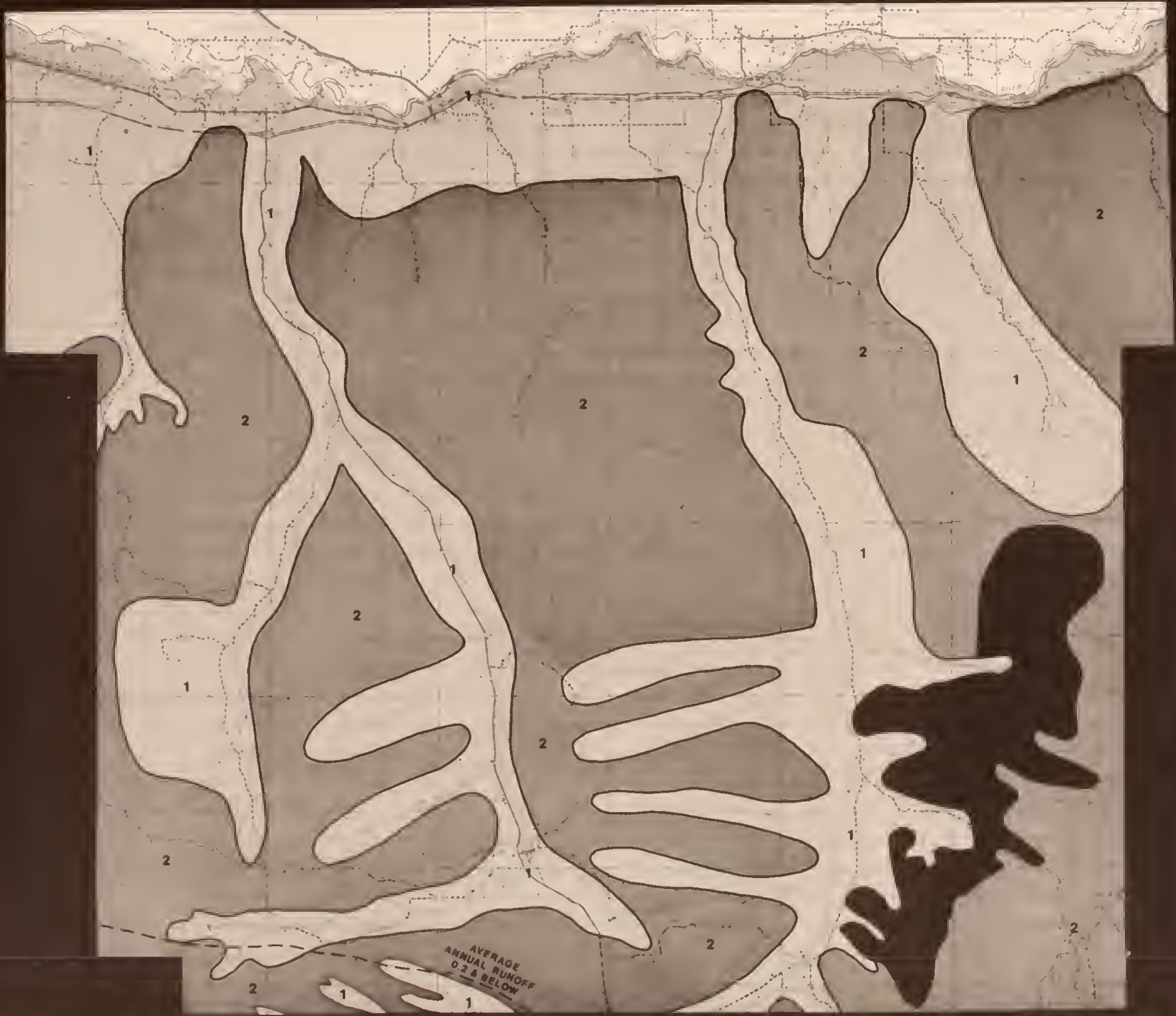
6.1.2.2 Water Pipeline

Natural Vegetation

The preferred route planned along the bottom of Armell's Creek will pass through 13 miles of grassland-sage and two miles of pine-juniper type (MPC, 1973). With a 60 foot right-of-way width, this will temporarily remove 113 acres from forage production and potentially more acreage because of obstacles to livestock movement. Revegetation will be easier in the gently sloping bottomland compared to the steep, sloping upland, both east and west of Armell's floodplain. Also, the soils in the bottom are more moisture-laden than upland soils because of a shallower water table and the runoff from the upland areas. If the profile in the alluvial soil is uniform throughout its depth of trenching, then the topsoil will not have to be as carefully sorted out compared to an area where the alluvial material is bedded. Uniform alluvial profile would only require a sorting of the black soil on the top (Morris, 1973).

Alternate route A (to the east of the preferred route) starts in section 21, T6N, R40E and traverses 11 miles of grassland-sage land and 1 mile of pine-juniper type. Thus, approximately 95 acres would be temporarily removed from natural forage production. Revegetation would be more difficult on the more sloping terrain. Also, erosion hazard is moderate under normal rainfall and extreme under cloudburst (Map: Erosion Runoff). Thus, the replacement of topsoil is more critical along this route than on the preferred one. Although forage production would be temporarily reduced from 1 to 2 years, this reduction would not be as critical as reducing production in the bottomlands. These bottomlands are used in the fall, winter, and late spring by livestock and wildlife until the upland forage is more tolerant to grazing. Since access is not as good as for the preferred route, more access roads would need to be constructed, with a resultant reduction in forage production and potential increase in erosion and in undesirable species.

Alternate route B (starting in section 18, T6N, R41E) would pass through 14 miles of grassland-sage land and 6 miles of pine-juniper type, thereby temporarily removing 158 acres from forage production. As with alternate A, topsoil would need to be carefully replaced, and access would be limited, causing the same effects.



COLSTRIP UNITS 1&2 ASSOC. FACILITIES – WATER SUPPLY & 115 KV LINE

EROSION
RUNOFF

LEGEND
- 1 SLIGHT
- 2 MODERATE
- ■ SEVERE

SOURCE
BLM 1972

ENERGY PLANNING DIV., DNR&C, HELENA, MT. • SCALE 1/2"=1 MI.

Agricultural Crops

About 94 acres will be removed from production along the preferred route that passes through 12 miles of cropland (primarily hayland). The impact of the pipeline along the bottom of Armell's Creek is more significant than for routes A and B. In a ranching operation the most critical land area is the hayland and pasture in the bottoms. Based on this, the rancher calculates how much hay he will need to purchase for adequate feeding of his stock through the winter. When it becomes necessary to buy hay because of a severe winter or loss in productive hayland, the solvency of the ranching operation is in jeopardy. The situation becomes more crucial when the cost of hay is high or hay is unavailable for purchase. 1/

Depending on the timing of the construction, a pipeline going through hayland or pasture will disrupt production from one to two years. If the pipeline is constructed in the fall after the last cut of the hay, the impact will be somewhat less than if it were constructed in the spring.

Route A will disrupt 13 miles of cropland or 102 acres down Smith Creek and a portion along Armell's Creek. This cropland disturbance is not as critical as for the preferred route because the cropland involved is not the key bottomland.

6.1.2.3 Transmission Line

Natural Vegetation

The impacts of the bare soil created by power pole holes, poles and

---

1/ For example, if hay is $40/ton and the rancher has 250 head of cattle and each head requires 1.5 tons to survive the winter, then it would cost $15,000 to feed the herd for the winter (Jackson, 1974).

access roads are the same as those mentioned in 6.1.2. Also, single poles in rangeland tend to be congregating points for cattle, especially before the wires are strung. This trampling by excess numbers can also result in bare areas subject to erosion and undesirable plants.

The preferred route for the 115 KV transmission line will affect 117 acres of natural vegetation. Some clearing would be required near the Yellowstone River, where the power line goes up side hills on the western edge of the valley (Map: Proposed Associated Facilities), and down near Colstrip. None of the proposed routes require large continuous corridor-like removal or strip clear-cutting of trees. Raparian or stream-side vegetation would be more altered compared to alternate routes A and B.

Both alternate routes A and B would require some tree removal on the north and east slopes of the upland areas where tree growth is the most dense. Because these timbered areas are small and discontinuous, the lineal distance of tree removal would be small. Alternate route B would require the largest amount of natural vegetation disturbance. Since access is less on routes A and B as compared to the preferred route, more temporary roads will have to be constructed. Route A will require less road construction than route B.

The effects of transmission line corona on vegetation are not yet known. It appears from what data exists that there are no effects at the 115 KV voltage level.

Agricultural Crops

As mentioned in 6.1.2.2, agricultural crops, the preferred route will disrupt more cropland than routes A and B. Potentially all the haying operations in Armell's Creek valley may be disrupted for the first year unless the power line is constructed along existing right-of-ways such as existing roads or fence lines. The poles disrupt the farming and ranching operations because equipment must go around them and there is always the chance that they may be knocked over. The proposed separate routes for the pipeline and power line in the preferred route compound the problem of disrupting farming operations in the Armell's Creek bottom.

Farming operations will be least affected by alternate routes A and B. Alternate route B will have the least amount of crop disturbance.

6.1.2.4 Surge Pond

Clay will be required to line a portion of the surge pond so that seepage loss will be reduced (section 3.2.4.1). The amount of sealing required will depend on the site ultimately selected. The applicant has indicated the clay is to come from borrow areas A and B if site 4 is chosen. This would require that topsoil be removed to expose the clay in subsoil. If the borrow areas are not reclaimed according to the Montana Mine Reclamation Act of 1973, then revegetation will be difficult or impossible. Similar reclamation is needed on borrow area sites C, D, F, and G near site 4 (Fig. 8).

Natural Vegetation

A proposed surge pond will change the terrestrial habitat into an aquatic habitat. The extent of this change depends on the total acreage flooded under the five alternative sites.

Site 1 (section 27, T2N, R41E), which is the smallest alternative, would flood about 32 acres. Most of this acreage is grassland-sage brush type with a minor amount in pine-juniper type. About 90 to 95% of the total 32 acres is capable of forage production.

Sites 2 and 3 in section 22, T2N, R41E are in the pine-juniper type. Grazing occurs in this vegetation type, but the approximate number of forage acres eliminated would be difficult to estimate. Sites 2 and 3 would flood about 80 and 96 acres respectively.

Site 4, which is the preferred location in section 28, T2N, R41E, would cover about 150 acres (Including both flooded area and structures). This site is predominantly in the pine-juniper type and a small amount is in grassland-sage brush type. However, since the map Existing Vegetation was prepared, most of the total acreage has been cultivated. Therefore, the amount of forage production lost is small.

Site 5 in section 32 and 33, T2N, R41E and section 4 and 5, T1N, R41E would inundate about 112 acres, which is 40% pine-juniper type. Forage production lost, as for sites 1, 2, and 3, would be considerable.

Agricultural Crops

Sites 1,2,and 3 would have no effect on agricultural crop production. Site 4 would have the greatest impact on agricultural production, compared to other sites (see section 6.2.10 for more detail). Only about 20% of the proposed area for site 5 would be removed from agricultural production.

6.1.3 Wildlife and Fisheries

6.1.3.1 Wildlife

This environmental assessment is being made without any specific field studies over the exact area in question. Numerous studies of the impact of various coal field developments on wildlife have been initiated. While none of them have progressed to completion or long-range evaluation, some data is becoming available, and from that data certain assumptions are being attempted in this particular assessment.

Intake Structure

The Intake structure at sites A or B would remove cropland thus eliminating a food supply for certain species of wildlife that depend, in part at least on domestic crops as a supplement to their diet. These species Include, but are not limited to, pheasants, hungarian partridge, and sharp-tailed grouse. The result of construction at either site will represent a displacement of habitat for these and other species.

The intake structure at alternate site C would remove some plant browse species which are utilized by deer for food and by upland game birds for cover.

The most significant effect from any of the intake sites is the water withdrawal from the Yellowstone River. Withdrawals, especially during low flows, may affect the temperature of the river to the point that the maximum tolerable temperature for some species is exceeded. Although the proposed 20 cfs withdrawal of water may seem totally insignificant in some respects, the fact remains that if water is removed during low flows it will obviously impact the system. It is also obvious that these withdrawals must be considered in the context of all probable future water withdrawals and not examined in the sense that it is to be the one and only withdrawal from the river. The cumulative effect on the Yellowstone aquatic life is likely to be highly significant.

The argument that the evaluation must be limited to each individual withdrawal and its effect on the system is no longer appropriate since the magnitude of the ultimate development is more than speculation. In comparing the three alternative sites, alternate A seems desirable since it requires fewer future dredgings to maintain the intake structure.

Pipeline

The preferred route down Armell's Creek bottom land would have more of an impact on wildlife than routes A and B. Habitat removal and temporary displacement will especially affect sharptail grouse, white-tail deer, and pheasant. Prairie falcon and golden eagles that occur along the Yellowstone River at the mouth of Armell's Creek and perhaps along Armell's Creek may be affected. Perch and nesting trees of the golden eagle could be removed and indiscriminate shooting along roads (a result of population influx) may reduce the number of golden eagles. Route A would temporarily remove some grassland-sage habitat and cause temporary displacement, but the general impact on wildlife would not be as great as for the preferred route. Route A does not go through as much bottom land as the preferred route. Route B would have the least wildlife impact compared to the preferred and route A, since the route goes through the least amount of stream bottom land.

Transmission Line

Power line construction would, in general, temporarily displace wildlife to adjacent areas. The increased population in these adjacent areas would quickly adjust to the carrying capacity of those sites.

The effects of electro-magnetic fields on wildlife are not clearly known. The low voltage 115 KV line will probably have very little effect on the general wildlife populations; however, quantitative data on this subject are fairly lacking at this time.

In the past, power lines (in particular distribution lines) have caused numerous cases of electrocution of raptors. In level or rolling prairies, these birds tend to alight on a pole and will be eletrocuted if the tip of one wing touches a conductor while the tip of the other wing becomes grounded (BSFW, 1973). It may be that transmission lines have some effect on birds, but once again, quantitative data on this subject are not available.

The removal of any trees along a route could result in the transmission line poles being more attractive as perching sites for raptors.

Surge Pond

Terrestrial habitat would be lost with any of the proposed sites. Thus, wildlife utilizing these sites would be displaced to adjacent areas with the same accommodation expected as mentioned earlier. Depending on the distance of the surge pond from human population areas, waterfowl might use the pond as a resting area during migration periods. There may also be a potential for nesting; however, this would be dependent upon the management plan for the facility and how that plan affects water levels.

Pond site 4 would have the greatest impact on pheasant, sharptailed grouse and deer due to habitat loss of all the other alternative sites. Site 5 would have the same effect, but to a lesser extent than site 4. Site 1, which is predominantly grassland-sage, would affect sage and sharp-tailed grouse habitat. Sites 2 and 3 would reduce deer cover and, possibly, some turkey habitat.

6.1.3.2 Fisheries

Of the three alternatives, the preferred route would have the greatest impact on Armell's Creek itself. Armell's Creek, while being an intermittent stream, has some game fish at its mouth and catfish are known to frequent that particular area in the spring. Residual pools along the length of Armell's Creek may have some small cyprinids and suckers. They may also be quite important to other semiaquatic or aquatic life forms, but, once again, no quantitative data to assess that impact is available. Even if care is taken while crossing streams, it is inevitable that construction equipment will cause at least temporary damage and the stream channel morphology could be altered. This, in turn, could cause basic changes in the stream, and it certainly could be magnified beyond the altered area as the stream, when carrying water, once again tends to reach an equilibrium with its floodplain.

Route B would affect fisheries less than route A since route B crosses the stream less often.

With present knowledge, transmission lines will have no major effect on fisheries, with the possible exception of some watershed or channel disruptions caused during the construction period that could conceivably contribute some sediment.

Relatively low voltage transmission lines like the proposed 115 KV line would probably not have any injurious effects on fisheries.

Transmission line alternative route 1 crosses the stream more frequently, and would have the most potential effect on that stream. There would be no appreciable difference between routes 2 and 3 in amount of impacts to fisheries.

It is conceivable that the surge pond could serve as a fish habitat, however, that would be totally dependent upon the pond's morphology and the management plan. These data are not available, so the value of these ponds is still undetermined.

Alternative sites 1, 2, and 3 limit the pond size to a degree that precludes the desirable storage capacity. Site 5 has the potential for larger pond size if modifications can be made.

The surge pond could serve as a fishing site and be stocked annually with fingerlings. The fishing potential depends on whether chemicals are going to be used, the size of the pond, the amount of plankton from the river which reaches the pond site, and the water quality at each pond site. The larger the pond size, the greater the fisheries potential.

6.1.4 Geologic and Hydrologic Impacts

Geologic and hydrologic impacts include a number of phenomena, both beneficial and adverse to man's activities. Some of the common geologic factors to be considered are as follows:

1. Foundation stability
2. Earthquake hazards
3. Interference with mining
4. Groundwater impacts
5. Impacts upon natural scenery
6. Impacts upon surface waters

Foundation stability can be endangered by a number of causes. Active faults, materials of weak bearing strength, and landslide areas should be avoided or taken into account when designing structures. It is not the intent of this study to evaluate the engineering design of the proposed facilities except as it pertains to environmental impacts; therefore, geological considerations of foundation stability are not examined in depth.

The Powder River Basin is not a seismically active area and earthquake and active fault hazards are relatively slight within the study area. Likewise, there does not appear to be any other particular hazards to the water supply system which could adversely affect the operation of the facilities.

Building a facility over a coal seam could affect future mining. Near Colstrip only two seams are being mined -- the Rosebud and McKay beds. The water supply system for Units 1 & 2 at Cosltrip would not be built over

Rosebud coal or significant amounts of McKay coal. The McKay and Stocker Creek coals occuring in the surge pond site are not economical deposits.

Below the McKay bed, the only potentially valuable coal is the Burley bed north of Colstrip and east of the proposed pipeline. Even if this bed were mined, the proposed pipeline would not interfere. Minable coals above the Rosebud seam only occur south of Colstrip.

Mining of the Rosebud bed is planned for areas northeast, southeast, southwest, and west of Colstrip. The proposed facilities will not interfere with this future mining.

Of the different aspects of this project, the transmission line, the pipeline and the intake structure will have negligible impact upon the groundwater. A significant leak in the pipeline may result in adding water to an aquifer but if detected would no doubt be corrected. Pipeline water entering an aquifer would have a similar impact on pond leakage which will be discussed below.

Only at the surge pond will water be potentially exposed to any aquifers. Any water leaking from the pond would be groundwater, temporarily at least. Except for leakage through the dam and dike, the Stocker Creek coal and overlying sandstone are the most likely rocks to receive water. The dam will be built on bedrock so the unconsolidated material on the floor of the reservoir will not transmit water except to the bedrock.

Impounded water in contact with the sandstone unit at the site may very well be transmitted to the Stocker Creek coal where it could be carried down dip. Some of the water may get into Armell's Creek. The amount of water-loss from the pond depends on the permeability of the sandstone. The Stocker Creek coal will probably be sealed from direct contact of the water by the clay layer to be placed immediately behind the dam. A significant amount of loss would be to the economic detriment of the power company. Measures would most likely be taken to reduce leakage if much loss occurs.

The Yellowstone River water is better quality than the groundwater near Colstrip. This is illustrated in the following table:

WATER QUALITY COMPARISON BETWEEN SHALLOW GROUNDWATER NEAR COLSTRIP AND YELLOWSTONE RIVER WATER

SUBSTANCE	YELLOWSTONE RIVER WATER AT MILES CITY	TWO WELLS NEAR COLSTRIP BELOW THE ROSEBUD COAL
Sodium	35 ppm	550-600 mg/l [1]
Chloride	4.1 ppm	7.9-13 mg/l
Sulfate	118 ppm	980-1700 mg/l

Therefore, if a significant change in the groundwater occurs, it should be to increase the quantity and quality of water in any wells that use the affected aquifers.

Scenery and recreational potential of an area depends largely upon the geology, vegetation, wildlife, and climate. The geological impacts which affect scenery and recreation are insignificant for all parts of the water supply system except the surge pond. Montana Power Company has made reference to the recreational potential of the surge pond (Westinghouse, 1973). Indeed,

[1] One part per million (ppm) is approximately one milligram per liter (mg/l).

the creation of a "lake" within a mile of Colstrip could enhance certain environmental amenities and provide recreation for the inhabitants of the community. Recreation in this area could include such activities as fishing, boating (perhaps limited to non-powered craft), swimming, bird watching, hunting, hiking, and photography. The scarcity of suitable bodies of water in the area would further increase the value of this facility. The pine-covered sandstone and clinker hills surrounding the pond site could contribute to the aesthetic value of a "lake" in this area. However, the surge pond as planned would destroy much of the potential recreational value of the site. The proposed borrow areas would remove most the the trees and reduce the hills in several critical areas around the pond. The diversity of the landscape created by the natural landforms and trees at both ends of the dam and elsewhere would thus be destroyed. Therefore, the poor selection of borrow areas and the destruction they would involve would partially defeat the implied goals of the company. The potential for enhancement of environmental quality would be lost.

The impacts upon surface waters of the proposed water supply system are difficult to assess. The greatest impact is the withdrawing of approximately 20 cfs from the Yellowstone River. In addition to decreasing the flow of the river, other impacts are felt as a consequence to the first. Quantitative data are not available at this time on such effects as any rise in water temperature and decrease in water quality. Investigations are underway and quantitative data on impacts of water withdrawal should be available in the coming months.

The impact of withdrawing and "consuming" 20 cfs from a low river flow of 2000 cfs does not seem significant. However, life in the river may be stressed at these times of low flow, and the increase in temperature and dissolved solids created by the water withdrawal may increase the stress to the point where the biological community may be damaged. Also, other water intake structures may be at the water level at these times, and any decrease in level may prevent other water users from having access to the water. However, the impact on the water level of withdrawing some 20 cfs is unmeasurable. For instance, at Billings a change of flow of 20 cfs would represent a change of stage (water level) of 0.013 feet at a river flow of 2000 cfs. At higher river flows the impact would be even less.

Another view of this impact shows that the 20 cfs to be taken from the Yellowstone River is only a small increment of what is likely to be requested by other coal-related industries in the Powder River Basin in the coming decades. To properly evaluate the impacts upon the river of the withdrawal of the water needed for Units 1 & 2, a more holistic approach is needed to understand the toal effect of which this 20 cfs is only a part. However, the total amount of water that may be withdrawn from the Yellowstone River in the future is unkown at this time; therefore, the true significance of this 20 cfs increment will not be known.

The construction of the pipeline will affect the water along Armell's Creek if stream crossings are made in the spring and early summer when the stream is flowing. Likewise some silting may occur in the Yellowstone when the intake structure is built if the work is done carelessly.

Leakage from the surge pond may enter Armell's Creek, but any increase in flow should be negligible. However, if there occurs a significant influx of water into Armell's Creek, the impact would be a positive one since the water quality of the stream would be enhanced.

Certain geological factors are intimately connected to the engineering of the water supply system. Where present, earthquake hazards, foundation stability hazards, and other geologic hazards to the facility must be properly taken into account or damage or destruction of the facility could result. Topography is of prime importance in the engineering of any water system. The functioning and cost of the components of the system are largely determined by topographic effects and how they are compensated.

Typically, a well-engineered water system would be compatible with the geologic characteristics of the region with regard to the functioning and economics of the system. However, those geologic parameters not affecting the functioning or cost, such as geologic aesthetics, pollution, or geologic impacts which may or may not be adverse upon other portions of the society, are often ignored. This is the case with the proposed water supply system being considered in this study.

6.1.5 Impact on Soils

The hazards of disturbing a creek valley such as Armell's are: (1) The center of ranch operations would be altered for at least 2 to 3 years. (2) Any irrigation by spreader dikes would be curtailed, especially if a trench were cut across them. The land tends to settle for several years. (3) Extra caution will be necessary in replacing top soil material. The high lime "C" horizons appear in all soil series. If this layer is put on the surface, the phosphorous is tied up for at least one year. Extra amounts of fertilizer are needed, and this should be considered when conpensating the rancher. The "B" horizon dark colored soils should be placed on top of "C" horizon soil when preparing the area for reclamation. (4) The Heldt, Lohmiller, Keiser and Nunn soils are either silty clay loam or clay soils. Running machinery across these areas when moisture is high will cause packing of the surface. Care should be taken to avoid construction work during and shortly after rainfall. (5) The chances of a high water table will exist near the stream, especially in heavier soil areas. Proper Investigation by augering test holes in such areas will save money and time.

6.2 Cultural Environment

6.2.1 Introduction

Because human value systems are involved, statements about impacts to the cultural environment should incorporate surveys of human responses and acceptance levels. Time and changing values frequently negate the prediction process, for what appears acceptable by existing standards may not meet with such favor by tomorrow's. For these reasons, statements on impacts, as below, carry implied as well as specific recommendations.

6.2.2 Conflict Zones

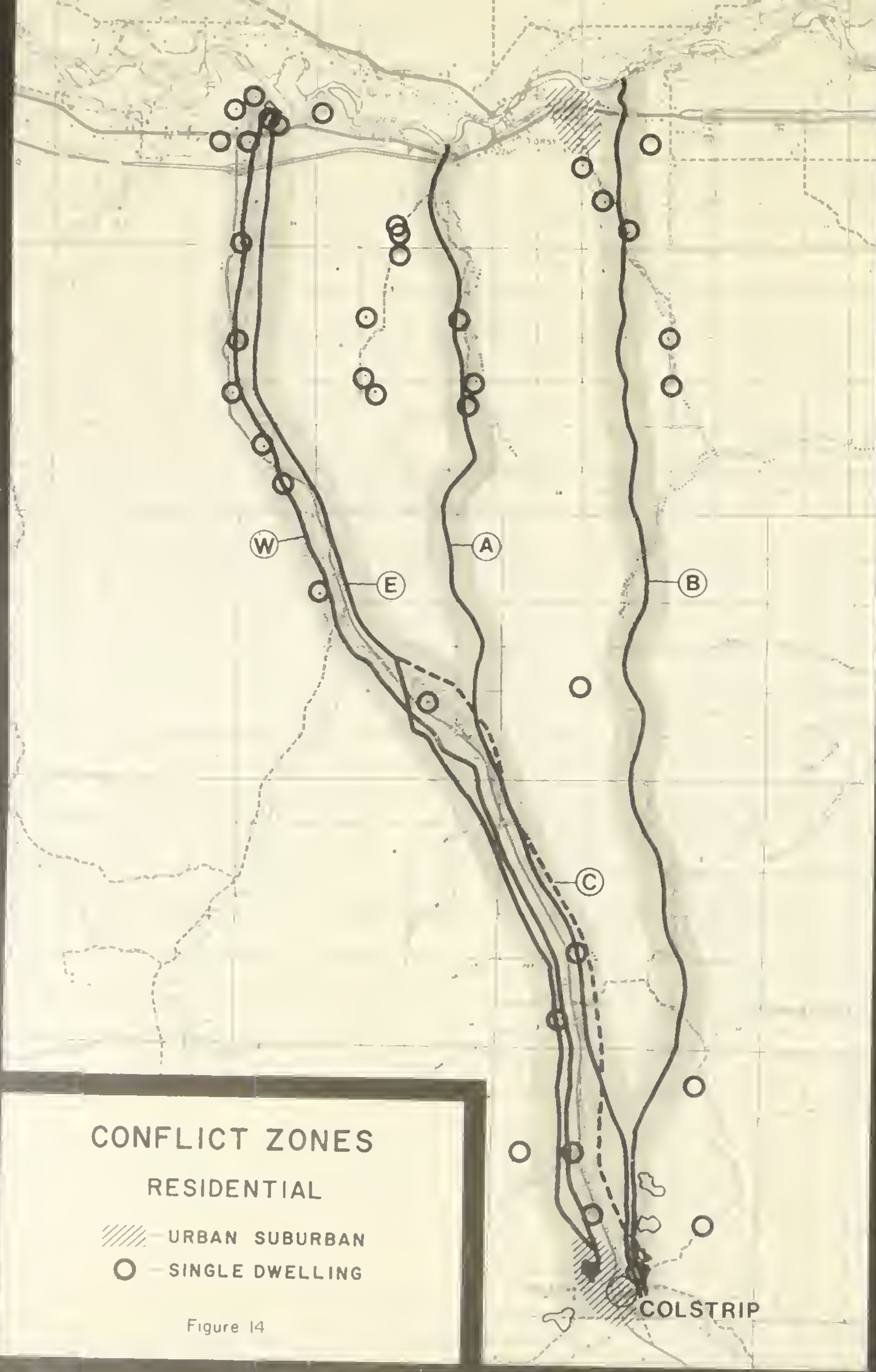
As an aid for visualizing cultural environmental impacts that would be caused by the proposed associated facilities, a series of "Conflict Zone" maps are included in this section. They are as follows:

Fig. 14	Residential-Urban-Suburban and single dwelling
Fig. 15	Ranching
Fig. 16	Transportation
Fig. 17	Utilities
Fig. 18	Scenic-Visual
Fig. 19	Agriculture, Existing (irrigated and non-irrigated)
Fig. 20	Potential Irrigation
Fig. 21	U. S. Mineral Rights
Fig. 22	Private Mineral Rights (all and partial)
Fig. 23	Surface Land Ownership

These zones do not infer particular weights or values to impacts, per se, but can be used as a tool during the evaluation process. As presented, they offer a visual description of areas that would be affected. Some routes would generate direct conflicts (such as at highway crossings); others would cause conflicts (such as scenic or visual) as a result of proximity.

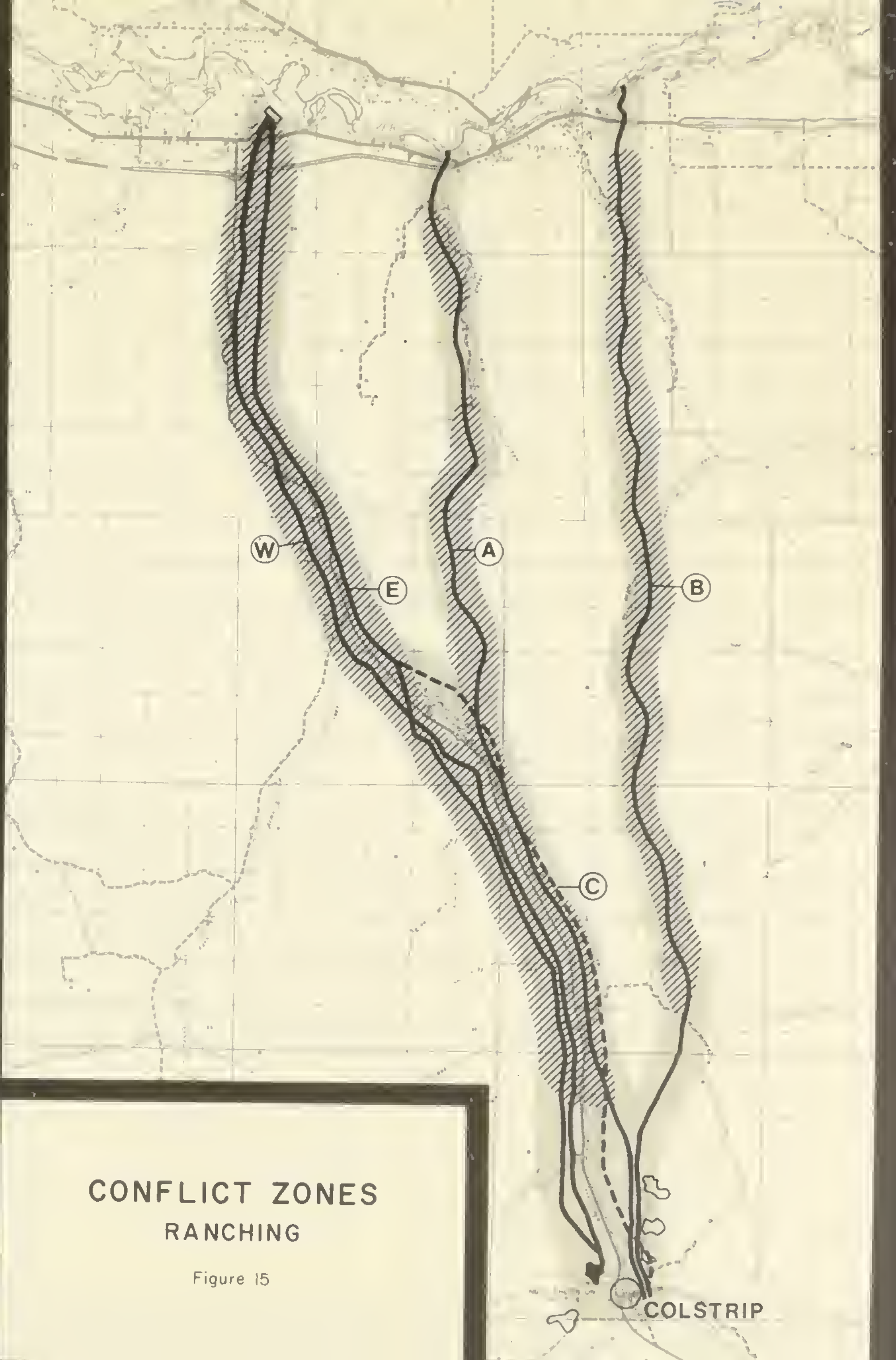
6.2.3 Population

Impacts to the study area's population will be insignificant from the water intake system and from any of the alternative routes or sites for the



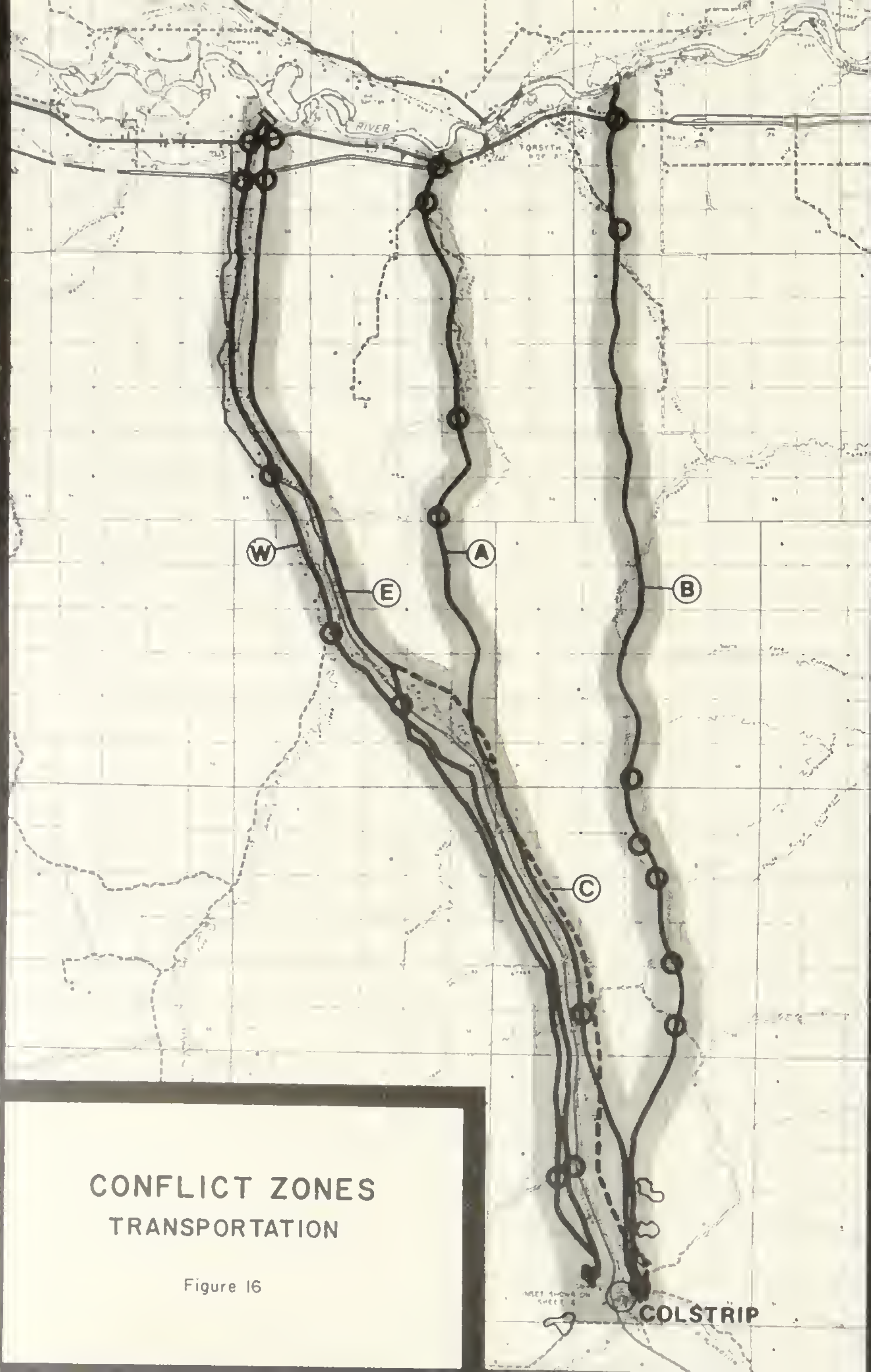
CONFLICT ZONES
RESIDENTIAL

Figure 14



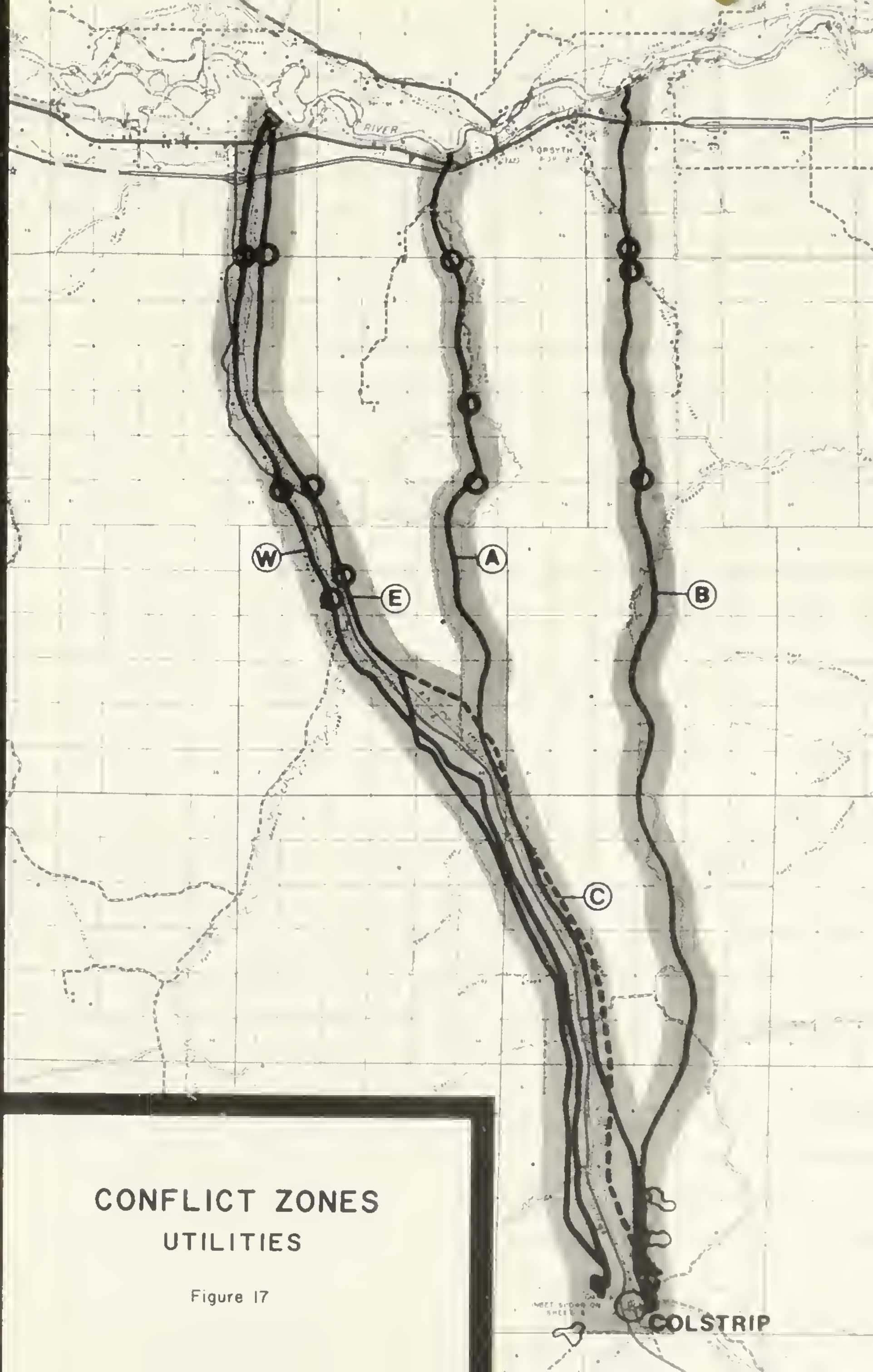
CONFLICT ZONES
RANCHING

Figure 15



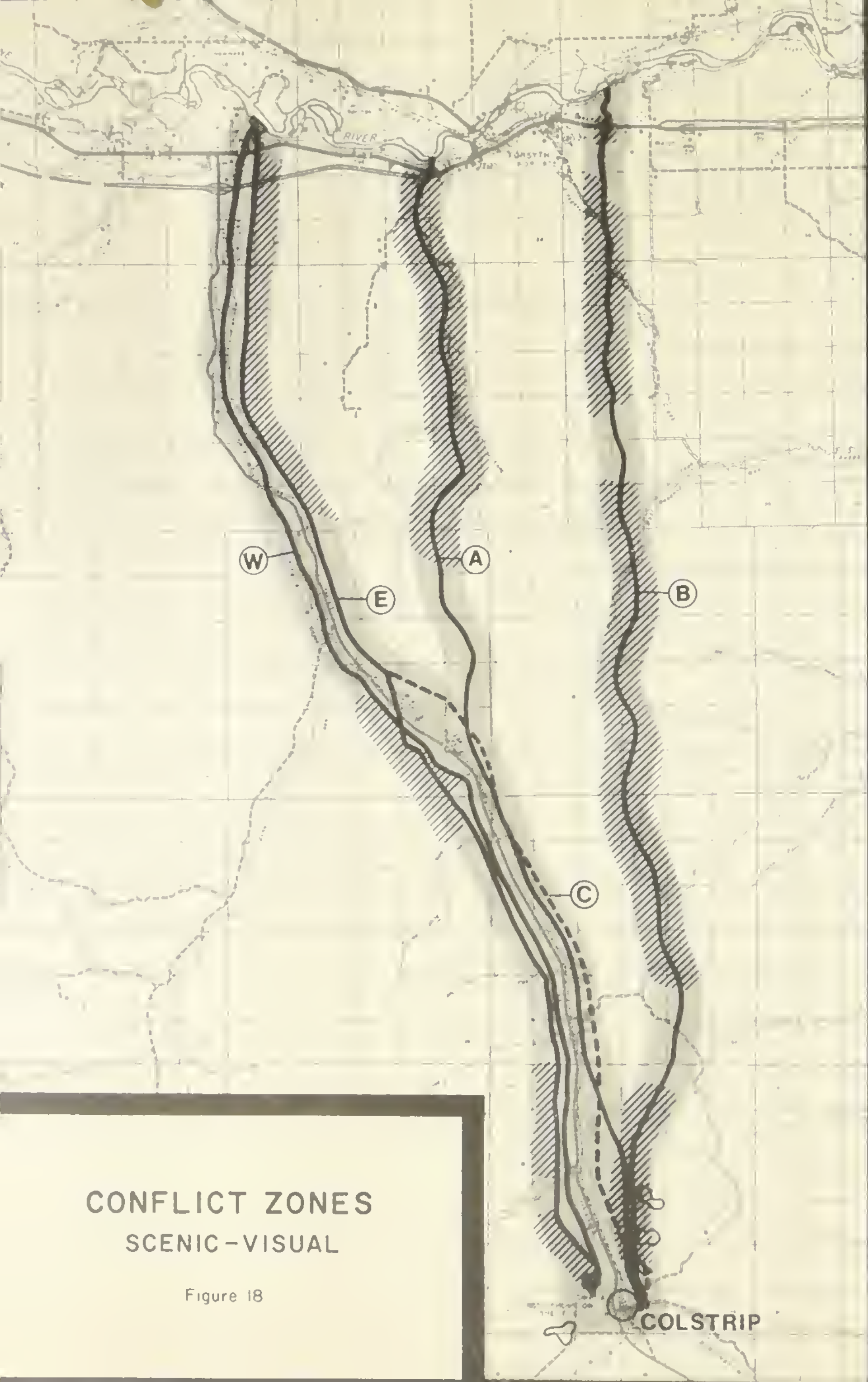
CONFLICT ZONES
TRANSPORTATION

Figure 16



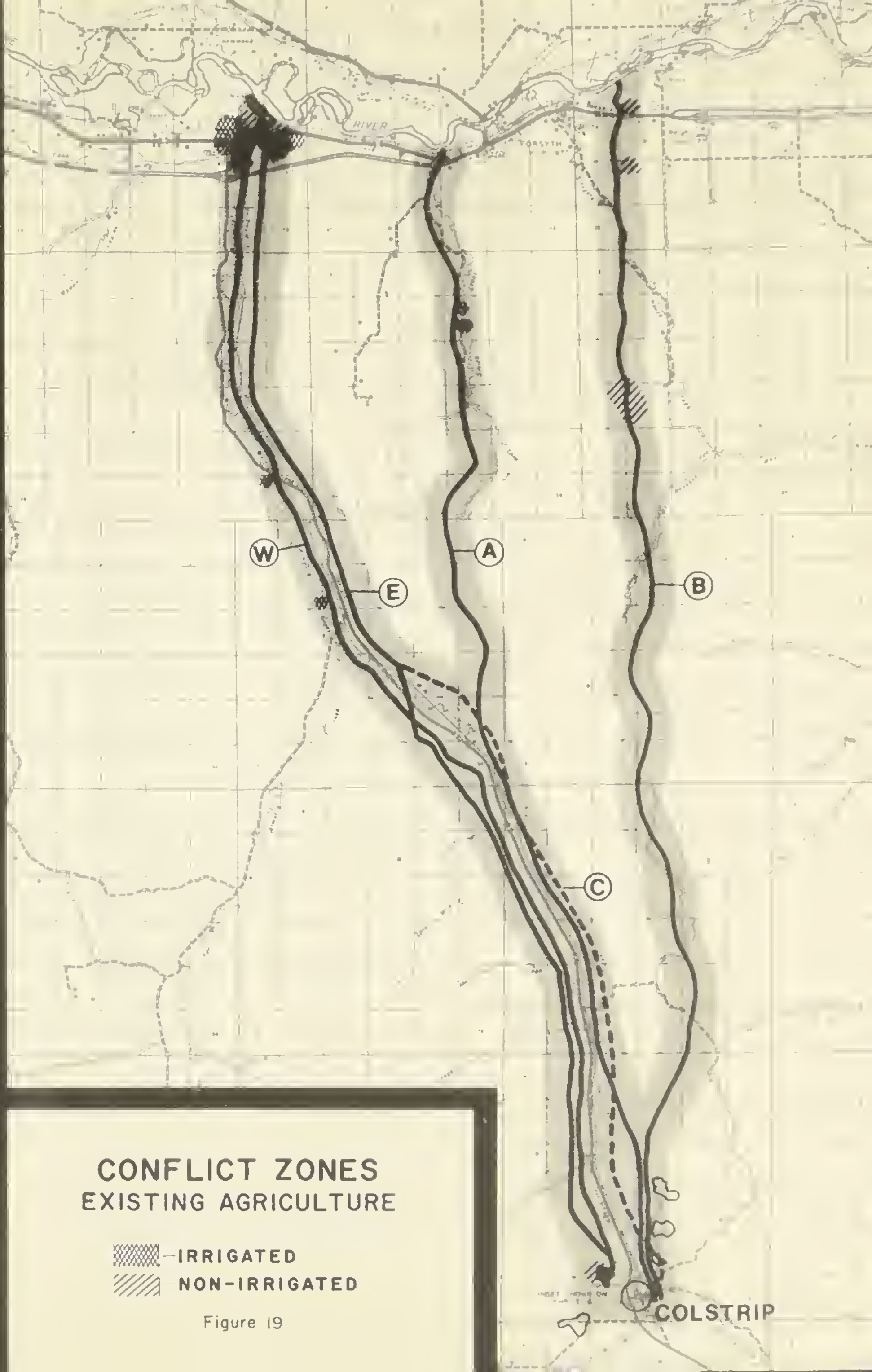
CONFLICT ZONES
UTILITIES

Figure 17



CONFLICT ZONES
SCENIC-VISUAL

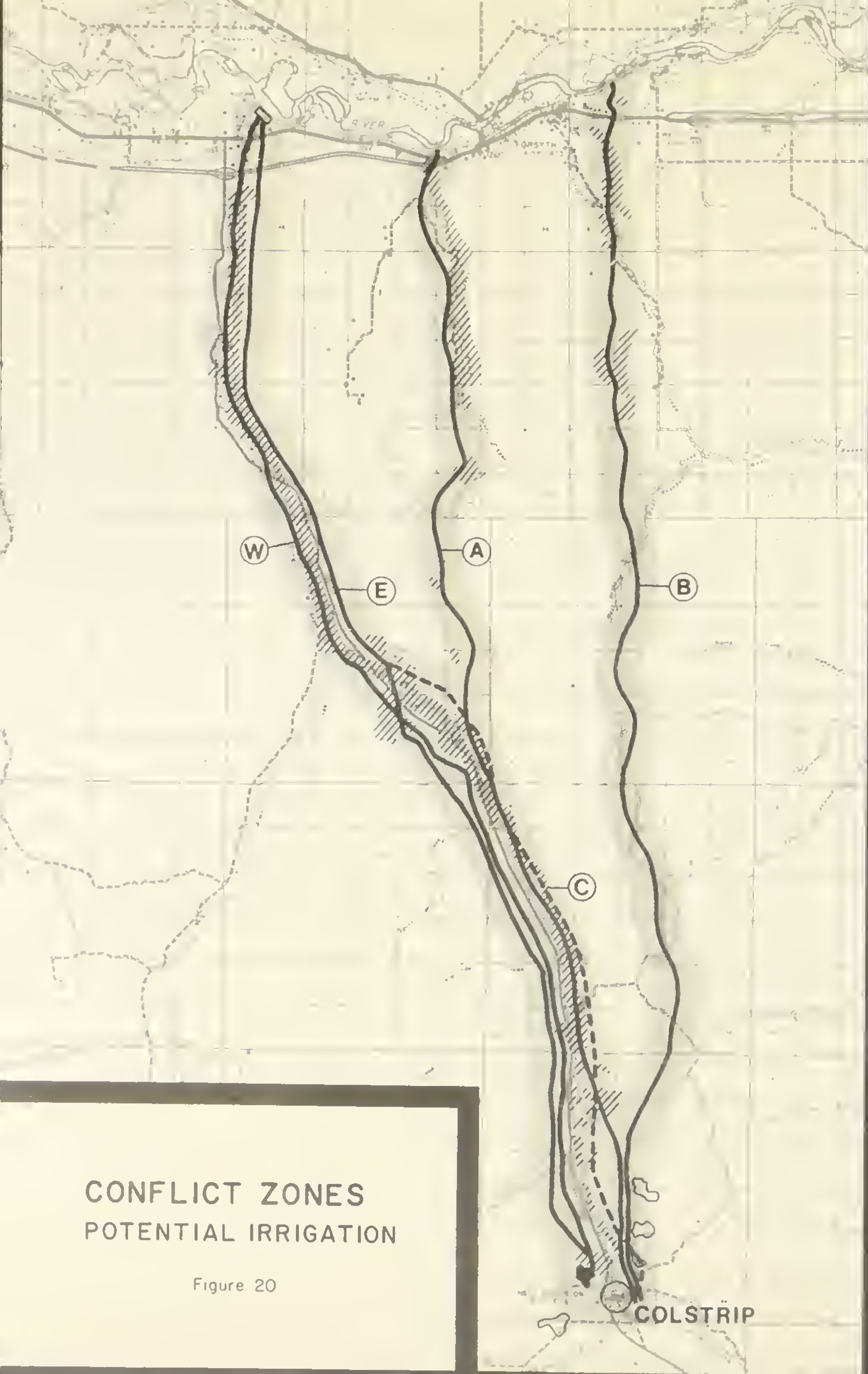
Figure 18



CONFLICT ZONES
EXISTING AGRICULTURE

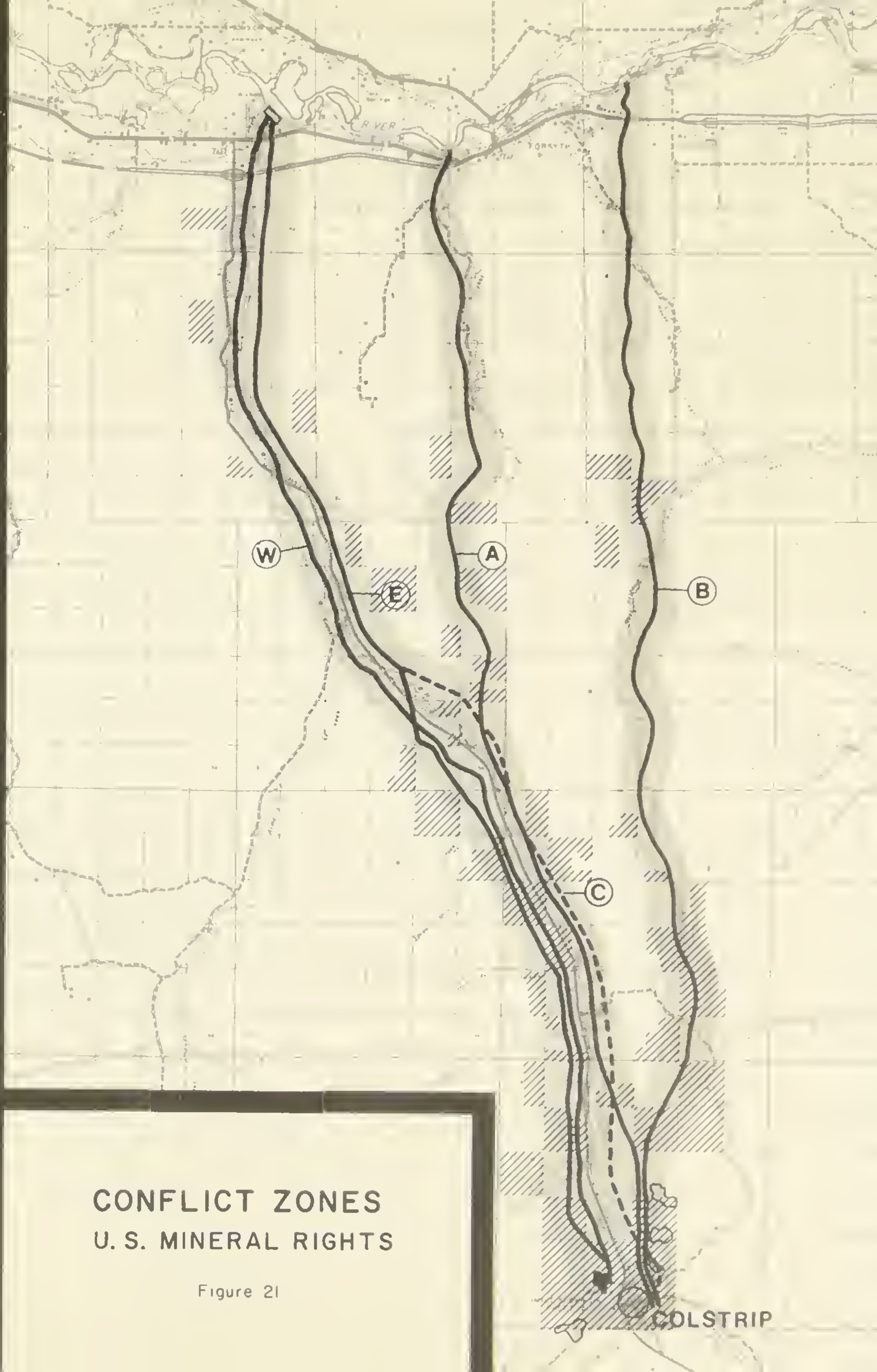
▨ -IRRIGATED
▨ -NON-IRRIGATED

Figure 19



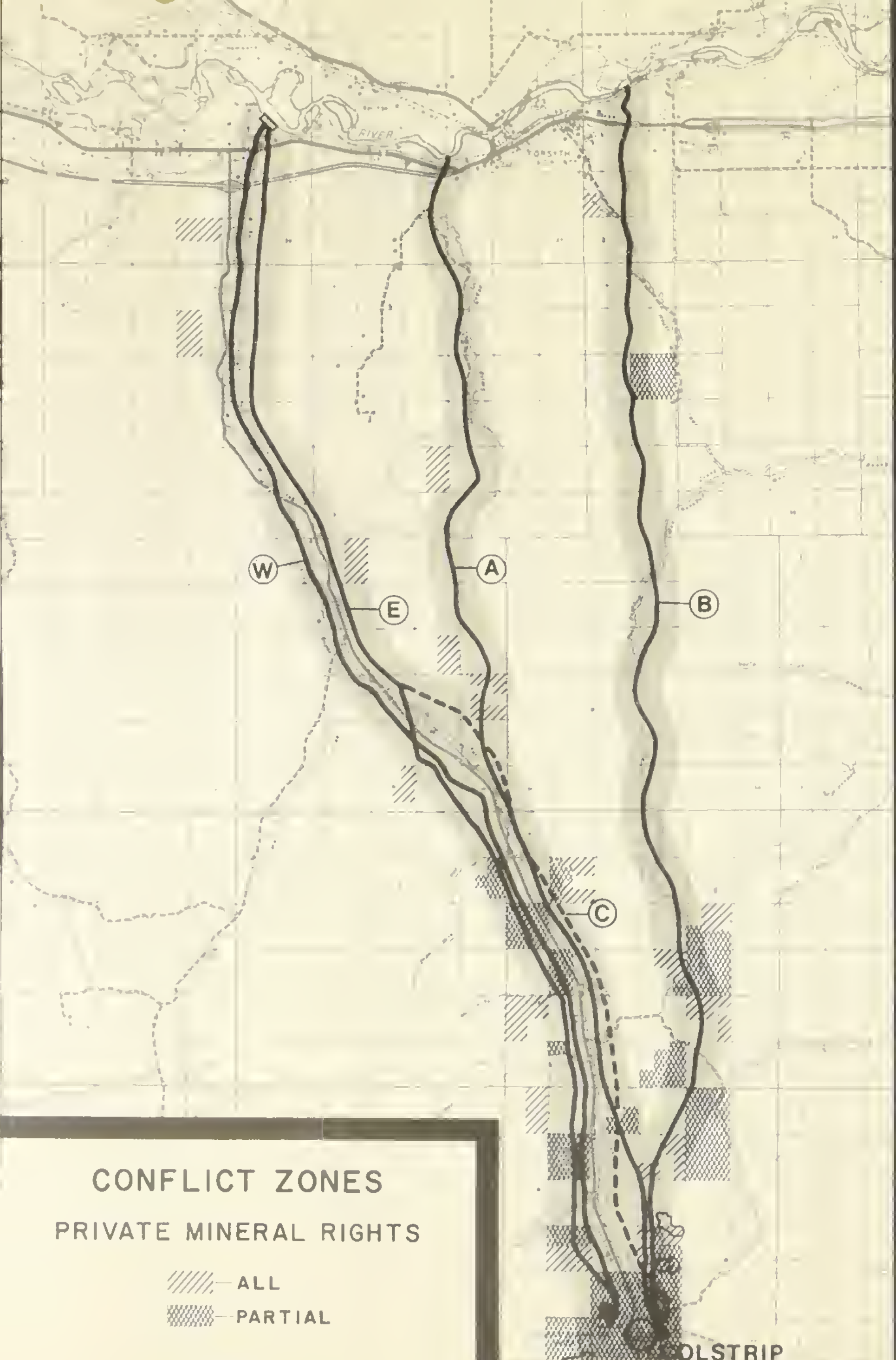
CONFLICT ZONES
POTENTIAL IRRIGATION

Figure 20



CONFLICT ZONES
U. S. MINERAL RIGHTS

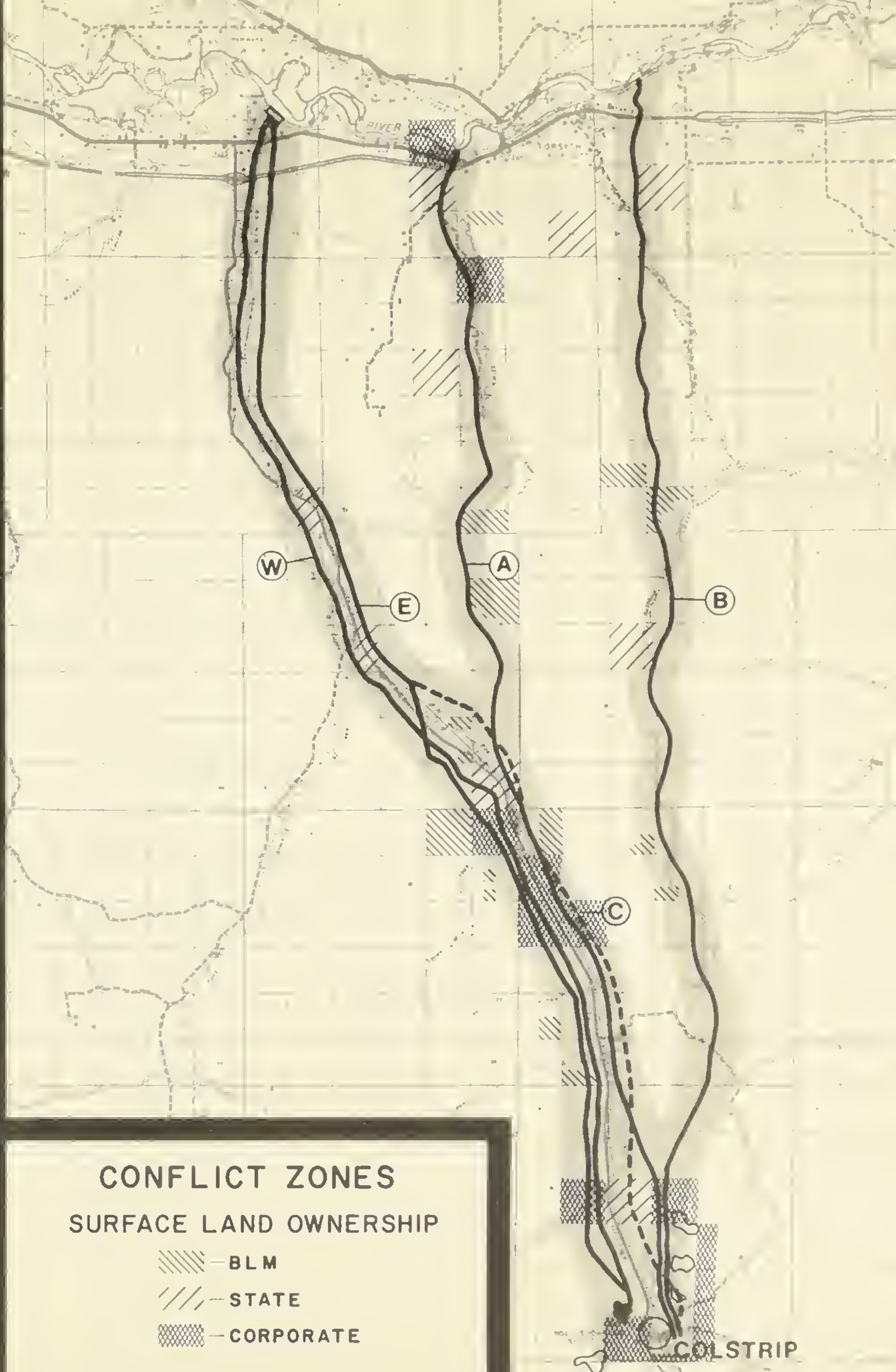
Figure 21



CONFLICT ZONES

PRIVATE MINERAL RIGHTS

Figure 22



CONFLICT ZONES

SURFACE LAND OWNERSHIP

Figure 23

pipeline, transmission line, and surge pond, because the increase caused by this construction will be a relatively small part of the total increase caused by general energy development.

6.2.4 Social Fabric

Impacts caused by the proposed facilities on the study area's social fabric will not be significant for the same reason given in the preceding paragraph.

6.2.5 Residential

Impacts from the proposed facilities on the residential sector will be negligible. However, as a result of proximity, scenic and/or visual interference cannot be avoided. Consequently the proposed facilities would have not only immediate but also long-range visual impacts.

6.2.6 Public and Quasi-Public

The pipeline and transmission line routes preferred by the applicant would affect public and quasi-public facilities by restricting options in future land-use. They would create an impact on section 28, T6N, R40E, as they would conflict with land-use plans formulated by the Department of State Lands for this area. The water intake system at the Yellowstone River and the surge pond would have little effect since there are no plans for use of this land for public or quasi-public facilities. Alternate pipeline and transmission line route B would have no effect except to limit future land use for public and quasi-public facilities to the immediate east of Forsyth.

6.2.7 Commerce

The water intake system at the Yellowstone River and the surge pond (at any of the alternative sites) will cause negligible impacts on the commercial sector. Commercial activity can be expected to continue to center in or near Forsyth and Colstrip. Impacts from any of the alternative pipeline and power line routes will also be minimal.

6.2.8 Transportation

The water intake system at the Yellowstone River and the surge pond at the site preferred by the applicant would have no impact on the study area's transportation system since it does not conflict with any existing or projected transportation facilities. Use of any of the alternate surge pond sites would create some local impact by restricting local road alignment near Colstrip. Conflict zones (Conflict Zone Maps, section 6.2.2) will be generated by all pipeline routes, especially the preferred alignment as a result of proximity to State Highway 315. Use of this pipeline route would situate Highway 315 between the proposed pipeline and the Burlington Northern Railroad, thereby restricting any future highway re-alignment, widening, or improvements. Right of-way footages required for improvements to Highway 315 should be coordinated between the applicant and the Department of Highways of Montana prior to considering application approval.

Regardless of route, the transmission line will create moderate impacts (primarily visual), especially where it crosses Interstate Highway 94, old State Highway 10, and State Highway 315.

6.2.9 Ranching

Impacts to ranching operations will depend on how many acres are taken out of winter forage and/or hay production as a result of installing a pipeline. The question of whether these disturbed areas can ever be restored to their original productive capacity remains unanswered. Another related question concerns the length of time for restoration or the number of growing and grazing seasons a rancher could expect to lose.

An estimated 94 acres (primarily hayland) will be disturbed by the 65-foot pipeline right-of-way along 12 miles of the preferred route. Non-irrigated hay production varies from 1.5 ton/acre for native hayland to 2.5 - 3.0 tons/acre with introduced grasses and alfalfa. Irrigated hay production varies from 4 to 5 tons/acre. Assuming a range of prices from $40 to $76 per ton, this translates to a production loss to a rancher of about $470 to $3,000 per mile of right-of-way across hayland. (These figures reflect dry native hay selling at $40/ton at 1.5 tons/acre as a low and $76/ton for irrigated hayland as a high).

The transmission line will require a 60' right-of-way. If the preferred route is used, the transmission line will disturb an additional 15 miles of cropland. The value of crops lost would be similar. Adjusting for the difference in right-of-way width, the loss would range from $435 to $2,770 per mile of transmission line across hayland for each year the land is out of production. To lesser degrees, similar impacts will result along alternate routes A and B, in that order.

The water intake system at the Yellowstone River will have little impact on ranching operations.

Any of the surge pond sites will generate impacts more to the agricultural sector than to ranching.

6.2.10 Agriculture

The water intake site at the Yellowstone River would take approximately 7-8 acres out of farm production. In addition, approximately 2.3 acres will be required to construct an access road from old Highway 10 to the site. Since agriculture in the study area represents only 5% - 6% of the land-use and is highly concentrated along the Yellowstone River, the loss of these few acres for farming will create a relatively larger impact to the agriculture in the study area. The pipeline and power line routes would create moderate impacts to existing farming operations but would cause greater impact to potentially irrigable land by their physical presence. Alternative A pipeline and power line route would create insignificant impacts to the existing agriculture sector but, again, would cause moderate to severe disruptions to potentially irrigable land. Alternate B routing would create some impact to existing non-irrigated farming operations and moderate impacts to potentially irrigable land. The preferred surge pond site would take approximately 100 acres of crop land out of production. Since the amount of agricultural land is small in the study area, this loss creates a relatively larger impact to existing agriculture. Alternate surge pond sites would create relatively insignificant agricultural impacts.

The potential for irrigated agriculture is discussed in Appendix C and Appendix D.

6.2.11 Recreation

The water intake system will automatically eliminate any access to the Yellowstone River at that point thereby creating a definite impact. Waterfowl might be encouraged to use the surge pond at any of the proposed sites thereby creating a positive impact on recreation. Also, the use of the surge pond for limited recreational activities (as a fish pond, picnic area etc.) could produce a second positive impact and should be considered by the applicant. Construction on any of the water pipeline or transmission line routes will cause some temporary interruption to game patterns but probably would not cause long run impacts. The visual impact caused by power lines is a recognized trade-off for the benefits of electricity. Driving, walking and sightseeing are Montana's three leading forms of recreation (Fish & Game, 1973) and they will be affected in the study area by the high visibility of trans mission lines on the landscape.

6.2.12 Historical-Archaeological

Although the water intake system would occur on the general site of Fort Alexander, historical impacts will be negligible (farming has already obliterated the site). Preferred and alternative water pipeline routes would produce negligible historical impacts.

Dale Fredlund (Research Archaeologist of the Mineral Research Center, Butte, Montana) has completed a preliminary survey of the preferred water pipeline and power line routes, as well as the Fort Alexander site, and has conducted other archaeological research within the study area (Map: Historical-Cultural Significance).

In general, open areas used for agriculture or grazing constitute the least potential for discovering archaeologic sites, as they have already undergone extensive surface remodification through farming and grazing operations. Sandstone outcroppings, on the other hand, constitute the greatest potential for discovering archaeologic sites (see 5.2.12). The greatest danger would be the destruction of unkown archaeological sites through oversite during the construction phases of any of the proposed facilities. Another danger is further disturbance of known sites through carelessness or indifference. Providing the former does not occur, impact from the water intake system would be negligible to the archaeological sector as would any of the surge pond sites. Homesteads and scattered archaeological finds were identified along the preferred water pipe and transmission line routes. However, since the physical conditions of the homesteads are in the advanced stages of deterioration, archaeological impacts will be insignificant. The two alternative routes A & B for the pipeline and transmission line appear to create no significant archaeological impacts.

6.2.13 Land Ownership

Any changes in the land ownership pattern will occur at specific sites, i.e., the water intake site and surge pond site. These will result in large-area land transferals. The water pipeline and transmission line will require easements for right-of-ways; consequently, actual transferal of land ownerships will not take place in these cases. Therefore, impacts to the actual land ownership sector will be insignificant.

6.2.14 Land Use Impact

Impacts to the existing land use pattern are a composite of the foregoing, and, although treated separately, each will have its definite effect on the total picture. In addition, the range of these impacts varies with each segment of the proposed associated facilities, thus ruling out the possibility of making a single blanket land-use impact statement. Complicated by uncertain projections, impact statements predicting future land-use patterns become even more difficult. Since the study area consists of a mix of private, public, corporate, state, and federal lands, it is clear that land-use decisions will continue to alter the total land-use pattern in piecemeal fashion. Inconsistencies could be reduced considerably with the creation of a comprehensive land-use plan that would establish a set of common objectives. Such a plan, then would incorporate the various long-range needs of each sector and could apply to all future land-use within the study area.

7 Conclusions

7.1 Comments

7.1.1 Adverse Impacts Which Cannot Be Avoided

The water supply system as proposed, will adversely affect the flow of the Yellowstone River. This primary effect will create secondary impacts upon the total Yellowstone River ecosystem. Although these impacts are not all known and cannot be quantitatively evaluated, they, nevertheless, do exist.

Other adverse impacts include the removal of a certain amount of agricultural land. This impact will be both temporary, such as along the route of the pipeline, and permanent, such as at the surge pond site. The aesthetic impacts of the intake structure at Nichols and the transmission line cannot be avoided if built as proposed.

7.1.2 Irreversible and Irretrievable Commitments of Natural and Economic Resources

A resource irretrievably committed in any project is the energy that is used to construct and operate the facility. The coal used to make the steel and gas or oil burned to make the cement are permanently lost. Materials used to construct the facility can be fabricated into new structures if the pipeline is dismantled but energy cannot be regained. Energy is committed in three different ways:

1. Energy used to manufacture the components and materials used in the proposed facility, i.e. the steel, aluminum, ceramics, pipe, wire, pumps, etc.

2. Energy used to construct the facility, i.e. diesel fuel used to dig the ditch, build the dam, transport the components, etc.
3. Energy used to operate the facility - some 3 MW of electrical power plus maintenance.

The changing of the landform to build the surge pond and pumping station can also be considered irreversible. Those trees and landforms that are destroyed will never be returned.

7.1.3 Relationship Between Local, Short-Term Uses of Man's Environment and Long-Term Effects

Man tends to think and plan for short time spans. One is most concerned about situations which affect him and persons closest to him in the present or near future than he is concerned about situations more removed in time and space (Meadows, 1972 and HES, March, 1973). Decisions are made upon what seems to be the best action to solve some short-term problem on the basis of what is known at the moment. A series of incremental decisions, each one in itself contributing little to a larger problem, can lead to a problem of great consequence. Many environmental problems have been created in just this manner.

The withdrawal of some 20 cfs of water from the Yellowstone River is the kind of small incremental damage which may, along wlth smaller withdrawals, destroy the desirable qualities of that body of water.

Flowing rivers have had a large influence upon the activities of man and the geographic distribution of his cities, industry, and other cultural features.

Man has viewed the rivers in his environment in many different ways. Rivers have meant life in the form of food they directly provide, soil they provide, or water for irrigation. Rivers have been transportation corridors and the means of moving people and commodities for millenia. Also rivers have been used as sewers for human and industrial wastes. A look at Montana history and present settlement patterns reveals the influence that rivers have had on the inhabitants of this state. As in the past, rivers provide for diverse activities in our present time. The Yellowstone River can be viewed as an entity in itself, encompassing many resources --- the water, the fish and wildlife dependent upon it, the recreational potential, the agates, sandbars, and all other aspects that comprise what we think of as "The Yellowstone River." Another view of this river is the consideration of only the currently economical resource --- a low place in the topography containing over a period of a year, some 6-10 million acre-feet of water. It is the person holding this second view who makes statements which imply that any flow is "excess" or "wasted" water. To be sure, the water in a river is a resource that can be utilized but when the future of the river rests on only the exploitation of that one resource to the detriment of other users of the river, those persons making the decisions are not acting in the best interests of the whole society.

Some of the interests pertaining to the Yellowstone River can be listed:

1. Preservation of the river as a naturally flowing body of water for its own value.
2. Preservation of biota which depend upon the river (fish, frogs,

muskrats, cottonwoods, invertebrates, willows, etc.) for their own value.

3. Recreational potential of the river (fishing, boating, etc.)
4. Source of water for cities and towns along the shores
5. Source of water for irrigation
6. Source of water for industry, especially coal-related

If water were withdrawn for one of these uses to the extent that the functions of the river for the other interests are significantly damaged, an inequity would exist.

The proposed withdrawal would be the first major use of water for coal-related industry but it appears not to be the last. The damage to the river ecosystem and the use of water for coal-related industry will most likely increase greatly within the next 30 years (minimum life of the plant). Already, applications are on file for another 1400 MW of generating capacity at Colstrip. It appears that a number of companies are considering power plants and gasification plants within the Yellowstone basin, a contention supported by the interest in water rights and coal leasing in southeastern Montana. Furthermore, President Nixon's announced policy to decrease this country's dependence upon foreign sources of energy by utilization of U.S. coal adds to the credibility of such plans as those expressed in the North Central Power Study and the Montana-Wyoming Aqueduct Study. It seems entirely possible that water use for coal-related industry will, without control, damage the other functions. The 20 cfs that will be withdrawn from the river for the proposed project is but the first installment of the toll this industry may take from the river.

The true impacts of removing 20 cfs from the Yellowstone for Colstrip Units 1 & 2 will be realized when this plant and all other users of the water (coal-related and others) reduce the river flow to the threshold of damage to other functions of the river. This threshold may be reached for the first three interests listed above before other water users may become affected (but not necessarily). The full significance of the withdrawal of these 20 cfs will be realized when an irrigator must go without water or another power plant may have to shut down or a gasification plant must stop producing gas, or when a father relates to his son how there used to be fish in this river before it became an intermittent stream.

7.1.4 General

7.1.4.1 Public Opinion

All too often the opinions and attitudes of persons being directly affected by the construction and presence of power facilities have remained in the background when the decisions to build or not to build are being made. This is an oversight which power companies and state agencies have both committed. The following paragraphs attempt to provide some insight into this topic area.

The landowners who have property in the area between Colstrip and Forsyth are almost universally opposed to the intrusion which the power facilities represent on their way of life. They feel that larger changes relating to coal development are inevitable, but the construction of even a small transmission line or water pipeline across their land seems to represent a clearer and more immediate problem in some respects than the presence of the main power plants. Most of the ranchers have lived in the area a long time (25 years is average), and they have generally taken individual approaches to this situation and made independent agreements regarding building activities on their land. However, they are unanimously agreed on one thing. The power companies' practice of paying only one fee for easement and construction of the lines should be changed. They contend that the presence of a power line and pipeline and the access roads needed to maintain them are a continuing source of inconvenience, not a one-time occurance. Ranchers owning land on the proposed pipeline-power line route feel that a yearly or periodic retainer fee from the power company would not be unreasonable to expect.

Another consideration which many of the ranchers would like to have is the right to tap into the pipeline for water for their livestock. The pipeline would thus be serving a dual need and the construction plans could still be altered at this point to accomodate the added use. This arrangement would cast a much more positive light on the proposed power facilities for these local residents because they would be assured of water at times when the Yellowstone tributaries are dry or very low.

Many of the landowners were first approached regarding easements for the proposed pipeline and power line well over a year ago. Most of the affected ranchers have been surveyed, but there is some degree of confusion and possibly needless worry by some ranchers over the effects of the lines and their exact location. According to the ranchers, this confusion may be partially attributed to inadequate explanations regarding impacts the lines may have on the area as well as several changes in plans and routes by the power company. The ranchers are unanimously agreed that the pipeline and transmission line should not cross through the bottom lands along Armell's Creek. Most of them want to see the lines put on the upland areas west of the highway or else far enough east so they will cross only hilly grazing land. Another suggestion was the possibility of corridor sharing with the railroad, highway, or telephone lines. In either case, the valuable crop and hayland along Armell's Creek bottomland would remain undisturbed.

There is not a great degree of consensus on the major problems which the pipeline or transmission lines may cause. The physical presence of the facilities (poles, pipe, etc.) doesn't seem to bother most of the ranchers. However, access roads and eventual maintenance activities cause quite a lot of concern.

The effect the pipeline may have on the amount of water available for agriculture and livestock and the success of eventual reclamation efforts seem to be the major areas of concern. At least two of the ranchers do not believe the 20 cfs figure given by Montana Power Company (to be pumped from the Yellowstone). They indicated that their own ranching operation require as much as 9-10 cfs when running at full capacity. One of these ranchers said, however, that if the 20 cfs figure is correct, it shouldn't hurt his operation.

Most of the ranchers were not greatly worried about reclamation of the construction areas. They feel that the vegetation will come back though they estimated it would take from 2 to 12 years before they could resume use of it for grazing.

This section of comments is intended to represent the current attitudes of landowners and ranchers in the Colstrip-Forsyth area. Contrary to what might be expected, most of these individuals are very well informed regarding factual aspects as well as potential impacts which coal development may have on their area. This is to say that many of them have a solid informational basis for feeling as they do.

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LIST OF SMALL MAMMALS
FOUND IN THE STUDY AREA
*MONTANA MAMMALS, MONTANA FISH & GAME DEPARTMENT, JANUARY, 1972

(G) Game Animal (P) Predatory Animal (F) Furbearer

Common Name	Scientific Name	Occurrence and Abundance
Masked Shrew	Sorex cinereus	Dry woods - common
Merriam Shrew	Sorex merriami	Sagebrush and grasslands - quite rare
Little Brown Bat	Myotis lucifugus	Throughout area - common
Yuma Bat	Myotis yumanensis	Throughout area - less common
Little Long-eared Bat	Myotis evotis	Throughout area - fairly common
Big Brown Bat	Eptesicus puscus	Throughout area - common
Richardson Ground Squirrel	Spermophillus richardsonii	Throughout area - common
Thirteen-lined Ground Squirrel	Spermophillus tridecemlineatus	Grasslands - common
Black-tailed Prairie Dog	Cynomys ludovicianus	Grasslands - less common
Least Chipmunk	Eutamias minimus	Sagebrush areas - common
Fox Squirrel	Sciurus niger	Yellowstone River bottoms - fairly common
Northern Pocket Gopher	Thomomys talpoides	Throughout area - common
Wyoming Pocket Mouse	Perognathus fasciatus	Dry areas - less common
Ord Kangaroo Rat	Dipodomys ordii	Sandy soil and sagebrush - common
Northern Grasshopper Mouse	Onychomys leucogaster	Grasslands - common
Western Harvest Mouse	Reithrodontomys megalotis	Grasslands - common
Western Deer Mouse	Peromyscus maniculatus	All habitats - common
White-footed Mouse	Peromyscus leucopus	Grasslands - common
Prairie Vole	Microtus ochrogaster	Dry grasslands - common
Sagebrush Mouse	Lagurus curtatus	Sagebrush areas - rare
Meadow Jumping Mouse	Zapus hudsonius	Meadows - less common
House Mouse	Mus musculus	Around human habitations - common
Porcupine	Erethizon dorsatum	Throughout area - common
White-tailed Jackrabbit	Lepus townsendii	Open areas throughout - common
Desert Cottontail	Sylvilagus audubonnii	Throughout area - common

BIRDS OBSERVED IN THE STUDY AREA

The following list contains 185 species identified in the area since 1936. This list, using species names, is in accordance with the Fifth (1957) A.O.U. Check-list and a list of Montana Birds by Dr. C.V. Davis (1973). Abundance symbols are grouped under column representing the four seasons of the year. These are defined as follows:

Seasons

S - March-May
S - June-August
F - September-November
W - December-February

Abundance

a - abundant
c - common
u - uncommon
o - occasional
r - rare

	S	S	F	W
Red-necked Grebe	r			
Eared Grebe	c	c	c	
Western Grebe	c	c	c	
Pied-billed Grebe	c	c	c	
Double-crested Cormorant	a	a	a	
Great Blue Heron	c	c	c	
Black-crowned Night Heron	c		c	
American Bittern	u	u	u	
Semipalmated Sandpiper	r		r	
Marbled Godwit	u	u	u	
American Avocet	u	u	u	
Wilson's Phalarope	c	u		
Herring Gull		r		
California Gull	c	a	c	o
Ring-billed Gull	c	a	c	
Franklin's Gull		c		
Forester's Tern	c	c		
Common Tern	c	c		
Black Tern	u	u	u	
Virginia Rail	r	r		
Sora	r	r		
American Coot	c	c	c	
Semipalmated Plover	c		c	
Killdeer	c	a	c	
Mountain Plover	u	u	u	
American Golden Plover	r			
Pigeon Hawk	c		c	
Sparrow Hawk	c	a	c	
Great Horned Owl	c	c	c	c
Snowy Owl				o
Burrowing Owl	o	u	o	
Long-eared Owl	c	c	c	c
Short-eared Owl	c	c	c	c

	S	S	F	W
Ruddy Turnstone		r		
Common Snipe	c	c	c	
Long-billed Curlew	u	u	u	
Upland Plover	u	o	u	
Spotted Sandpiper	c	c	c	
Willet	c	u	c	
Greater Yellowlegs	c	c	c	
Lesser Yellowlegs	c	c	c	
Pectoral Sandpiper	r			
Baird's Sandpiper	c		c	
Least Sandpiper	c		c	
Turkey Vulture		o		
Goshawk	o		o	
Sharp-shinned Hawk	c	c	c	
Cooper's Hawk	o	o	o	
Red-tailed Hawk	a	c	a	
Broad-winged Hawk	r	r		
Swainson's Hawk	c	c	c	
Rough-legged Hawk	c		c	c
Ferruginous Hawk	r	o	r	
Golden Eagle	c	c	c	c
Bald Eagle	c	u	c	c
Marsh Hawk	c	a	c	c
Osprey	c	c	u	
Prairie Falcon	c	c	c	
Peregrine Falcon	c	o	c	
Snow Goose	u		u	
Blue Goose	r			
Mallard	a	c	a	a
Gadwall	c	c	c	
Pintail	a	c	c	o
Green-winged Teal	c	c	c	
Blue-winged Teal	c	a	c	

	S	S	F	W
Saw-whet Owl	c	c	c	c
Poor-will	c	a	c	
Common Nighthawk	u	a	a	
Sharp-tailed Grouse	c	c	c	c
Sage Grouse	c	c	c	c
Ring-necked Pheasant	c	c	c	c
Gray Partridge	c	c	c	c
Turkey	u	u	u	u
Sandhill Crane	c		c	
Red-breasted Nuthatch	c	c	c	
House Wren	c	c	c	
Long-billed Marsh Wren	r	c	r	
Rock Wren	c	o	c	
Catbird	r	o	r	
Brown Thrasher	c	c	c	
Robin	c	a	c	o
Swainson's Thrush	o	u		
Western Bluebird	c	o	c	
Mountain Bluebird	c	a	c	
Golden-crowned Kinglet	c		c	
Ruby-crowned Kinglet	c		c	
Sprague's Pipit	c		c	
Bohemian Waxwing	c		c	a
Cedar Waxwing	c	u	u	c
Northern Shrike	c		c	o
Loggerhead Shrike	u	c	u	
Starling	c	c	c	c
Red-eyed Vireo	u	o		
Warbling Vireo	r	o	r	
Yellow Warbler	c	c	c	
Myrtle Warbler	r			
Audubon's Warbler		u		
Ovenbird		u		
Yellowthroat	c	c	c	
Yellow-breasted Chat	u	u		
Wilson's Warbler	u		u	
American Redstart	u	u		
House Sparrow	a	a	a	a
Bobolink	c		c	
Eastern Meadowlark	c		c	
Western Meadowlark	a	a	a	
Western Canada Goose	c	c	c	
Richardson's Canada Goose		r	r	
White-fronted Goose	o		o	
Yellow-headed Blackbird	c	a	c	
Red-winged Blackbird	c	a	c	
Baltimore Oriole	o			
Bullock's Oriole	c	c		
Brewer's Blackbird	c	a	c	
Common Grackle	o	c	o	

	S	S	F	W
Cinnamon Teal	r		r	
American Widgeon	c	c	c	
Shoveler	c	c	c	
Redhead	c	u	c	
Ring-necked Duck	o		o	
Canvasback	c	u	c	
Lesser Scaup	c	u	c	
Common Goldeneye	c	u	c	c
Barrow's Goldeneye	o		o	
Bufflehead	c	u	c	o
Oldsquaw			r	
Ruddy Duck	c	u	c	
Common Merganser	c	u	c	c
Red-breasted Merganser	u		u	
Mourning Dove	a	a	a	
Ruby-throated Hummingbird	c	c	c	
Belted Kingfisher	c	o	c	
Yellow-shafted Flicker	c	o	c	
Red-shafted Flicker	c	a	c	
Red-headed Woodpecker	c	c	c	
Hairy Woodpecker	c	c	c	
Downy Woodpecker	c	c	c	c
Eastern Kingbird	c	a		
Western Kingbird	c	o		
Say's Phoebe	c	c	c	
Traill's Flycatcher		o		
Western Wood Peewee	r	o	r	
Horned Lark	a	a	a	u
Violet-green Swallow	r		r	
Tree Swallow	c	u	c	
Bank Swallow	c	a	c	
Rough-winged Swallow	o	o		
Barn-Swallow	c	c	c	
Cliff Swallow	c	c	c	
Purple Martin	u		u	
Gray Jay	u	u	u	u
Blue Jay	u	o	u	
Steller's Jay	u	r	u	
Black-billed Magpie	c	a	c	a
Common Raven	r	o		
Common Crow	c	c	c	
Pinyon Jay	c	a	c	
Clark's Nutcracker	r		r	
Black-capped Chickadee	c	c	c	c
Rufous-sided Towhee	c	c	c	
Lark Bunting	a	a		
Savannah Sparrow	u	o	u	
Vesper Sparrow	u	c	u	
Lark Sparrow		r		
Slats-colored Junco	c		o	

	S	S	F	W
Brown-headed Cowbird	c	c	c	
Western Tanager	c		c	
Black-headed Grosbeak	u		u	
Indigo Bunting		r		
Lazuli Bunting	r	u	r	
Common Redpoll				c
Pine Siskin	c			
American Goldfinch	c	a	c	
Red Crossbill	u	c	u	
Rose-breasted Grosbeak	c	u	c	

	S	S	F	W
Tree Sparrow	c		c	o
Chipping Sparrow	c	a	c	
Harris' Sparrow	c		c	
Brewer's Sparrow	r	r		
White-crowned Sparrow	c		c	
Song Sparrow	c	c	c	
McCown's Longspur	o		o	
Lapland Longspur	c		c	c
Chestnut-collared Longspur		c		
Snow Bunting				o

EXPLANATION
LAND CLASSIFICATION FOR POTENTIAL IRRIGATION PLANNING
WATER RESOURCES DIVISION
of the MONTANA
DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

INTRODUCTION

The major features that determine the desirability of an area for irrigation development are the type of soil, topography, availability and quality of irrigation water, and the climate and markets. Soils and topography, together with frost free season and mean temperature largely determine the ability of an area to produce, assuming that a dependable water supply is available, and finally a market is necessary to obtain a profit from crops that are produced. This land classification is based on a long range projection which disregards the present available water supply for irrigation and market factors of crops produced.

Land classification is the process by which soils, relief and climate are systematically appraised and lands are placed in categories based on similarity of characteristics. Land classification surveys made by the Water Resources Division of the Montana Department of Natural Resources and Conservation are specifically designed to establish the degree of suitability of land for sustained irrigation farming. The objective is to outline the land areas that have a potential for irrigated agriculture. Because technological advances in irrigation are taken into account, slope and surface topography become less important as rapid expansion of sprinkler irrigation takes place.

The land classification survey separates the land areas into (1) lands having potential for irrigation termed "irrigable" in contrast to (2) the inferior "non-irrigable" lands which are unsuited for present or future irrigation because of unfavorable characteristics. The term "irrigable land" as used in this reconnaissance classification, includes land with soils topography and drainage features that are suitable for irrigation by gravity or sprinkler methods.

Lands classed as "irrigable" have soil, topography and climate that will support sustained irrigated agriculture with proper water management, drainage and other necessary conservation practices.

Lands which are classified as "irrigable" are divided into classes on the basis of their relative suitability for irrigation farming. Class 1 represents irrigable land with potentially high productive value; class 2 represents land of intermediate value, and class 3 includes land of the lowest value that may be suitable for irrigation.

The intensity of this land classification is a general reconnaissance survey. Any future project development should be based on a detailed study to pinpoint the exact location and limits of the land best suited for irrigation.

Irrigation Alternative

The construction of a pipe line by industry should consider the agriculture benefits that could be derived from such an endeavor. Montana's livestock production will need to increase approximately 2.5 times before the year 2020 in order to satisfy needed increases in red meat, mainly beef. The needed expansion by using rangeland is limited because of the climatic conditions restricting plant growth; the range specialist allow about one-fourth increase in range production by conservation, fertilization and other factors. Any increase over the one-fourth is limited by climate. The other alternative, then, is more production by irrigation, which is also necessary for better utilization of the rangeland when considering the one-fourth.

The Armell's Creek Valley could easily be irrigated by low head gravity sprinkler systems without extra pumping at the farm level. The pressure for running sprinklers would be there in the pipe line.

The soils of the valley are generally favorable for irrigation. The McRae, Fort Collins, Lohmiller and Haverson soils are some of the better producers under irrigation in Montana. In general, if correctly managed, seepage and salinity problems would be held at a minimum. These soils should be very adaptable to sprinklers because the loam and clay loam surface "A" and "B" horizons have a very good moisture holding capacity and intake rate of moisture. They can be irrigated with average sprinkler heads, and with a minimum amount of surface run-off. The overall moisture capacity for a 4-foot rootzone is about 7 to 9 inches.

Our reconnaissance land classification (Appendix C) of the Armell's Creek Valley from Colstrip to the Yellowstone River shows 6,081 irrigable acres of land, of which 49 acres are Class 1, 5,824 acres are Class 2, 208 acres are Class 3. The land classification is of a general reconnaissance level, and does not take into account right of ways for roads, railroads, small stream channels, or irrigation ditches. Armell's Creek has both a highway and railroad running through portions of the valley bottomland; the stream channel should also be considered. A conservative estimate of a 30% reduction of irrigable land should compensate for the above mentioned reductions, plus accounting for small Class 6 areas. The irrigable acres after the 30% reduction would be 34 acres of Class 1, 4,077 acres of Class 2, and 146 acres of Class 3, with a total of 4,257 acres to consider water supply for.

The Armell's Creek Valley is a ranching area. Typical irrigation distribution for the Forsyth area is: 33.3% alfalfa, 33.3% corn silage, 10% grass and pasture, 23.3% irrigated grain of barley and wheat. These percentages of crops are from the Soil Conservation Service at Forsyth. Assuming that this crop rotation could apply to Armell's Creek, if water were available, the following computations determine irrigation water requirements.

First we have the Soil Conservation Service consumptive water requirements for different crops for the entire state. The requirements for Forsyth would be similar to the Armell's Creek area.

Irrigation Requirements with an Annual Rainfall 12.17 Inches

at Forsyth, Montana

Alfalfa - Acreage 33.3% of Potential Irrigated Area

Month	Consumptive Water Requirement (acre inches per acre)	Effective Rainfall (acre inches per acre)	Irrigation Requirements (acre inches per acre)	Adjusted for Percent of Crop Grown in Area
April	0.34	0.10	0.24	.08
May	4.17	1.58	2.58	.86
June	6.14	2.30	3.84	1.28
July	8.23	1.27	6.95	2.32
August	6.81	0.80	6.00	2.00
September	3.69	0.78	2.90	.97
October	0.28	0.09	0.18	.06
Seasonal Total	29.66	6.92	22.69	7.57

Month	Consumptive Water Requirement (acre inches per acre)	Effective Rainfall (acre inches per acre)	Irrigation Requirements (acre inches per acre)	Adjusted for Percent of Crop Grown in Area
	Corn for Silage - Acreage 33.3% of Potential Irrigated Area			
April	-0-	-0-	-0-	-0-
May	1.20	0.87	0.32	.11
June	3.31	1.92	1.38	.46
July	6.90	1.15	5.74	1.91
August	6.87	0.78	6.08	2.03
September	3.26	0.67	2.59	.86
October	-0-	-0-	-0-	-0-
Seasonal Total	21.54	5.39	16.11	5.37
	Grass - Acreage 10% of Potential Irrigated Area			
March	-0-	-0-	-0-	-0-
April	1.12	0.36	0.76	.08
May	3.45	1.46	1.99	.20
June	5.00	2.07	2.92	.29
July	6.82	1.13	5.69	.57
August	5.82	0.72	5.09	.51
September	3.24	0.73	2.51	.25
October	1.13	0.40	0.72	.07
November	-0-	-0-	-0-	-0-
Seasonal Total	26.58	6.87	19.68	1.97
	Grain - Acreage 23.3% of Potential Irrigated Area			
March	-0-	-0-	-0-	-0-
April	0.54	0.30	0.24	.06
May	3.32	1.48	1.83	.42
June	6.86	2.34	4.51	1.04
July	6.58	1.13	5.44	1.25
August	0.82	0.35	0.47	.11
September	-0-	-0-	-0-	-0-
Seasonal Total	18.12	5.60	12.51	2.88

Irrigation Requirements Per Acre of Land in the Armell's Creek Valley Assuming an Average Acre is 33.3% Alfalfa, 33.3% Corn Silage, 10% Grass and 23.3% Grain

Growing Season	Alfalfa	Corn Silage	Grass	Grain	Consumptive Irrigation Requirement for One Acre of Irrigated Land
March	.00	.00	.00	.00	.00
April	.08	.00	.08	.06	.22
May	.86	.11	.20	.42	1.59
June	1.28	.46	.29	1.04	3.07
July	2.32	1.91	.57	1.25	6.05
August	2.00	2.03	.51	.11	4.65
September	.97	.86	.25	.00	2.08
October	.06	.00	.07	.00	.13
Total	7.57	5.37	1.97	2.88	17.79

The computed values of net irrigation requirement do not take into account either water application efficiency, or water conveyance efficiency, both of which must be considered when determining the total irrigation requirement for a field or farm. The water efficiencies would be very high in this area. The soil characteristics are very adaptable for sprinkler irrigation. Canal losses would be at a minimum because of sprinkler lines; perhaps a few open canals would be necessary on areas for away from the pipe line. The water loss from sprinkling would be due to high winds, and high summer temperatures causing evaporation; some loss would also be due to the water percolating through the soil profile. The estimated water conveyance loss to the farm would be near zero, and the water application loss on the farm is estimated at 25%. The computed amount of water required for irrigating one acre of land is 1.98 A.F..

The irrigable land area is 4,257 acres, when assuming 30% loss of acreage due to right of ways, etc. The estimated irrigation requirement to irrigate the Armell's Creek area is 8,429 A.F. of water.

The expected yields for crops grown would be higher than the average irrigated yields because of better soils, irrigation water management and higher water costs. The higher water costs would cause better farm management, fertilization and growing of higher yielding crops. Otherwise, the irrigating would not pay. The expected yields per acre are estimated at: alfalfa - 5 ton; corn silage - 18-20 tone; irrigated native hay - 3.5 ton; irrigated pasture - 7 AUM; barley - 60 bushels; wheat - 65 bushels. The yields are higher than county averages because the soil is better and the iriation management by sprinklers is also better.

The crops would receive 3 irrigations for alfalfa; 2 to 3 for silage corn; 3 for grassland and 2 for grain.

The amounts of water mentioned in this report should be considered as basic information. The totals of water for release from a pipe line would need to be determined.

The greatest requirement for irrigation will be during the month of July in which one acre of land will require approximately 6 inches of water.

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